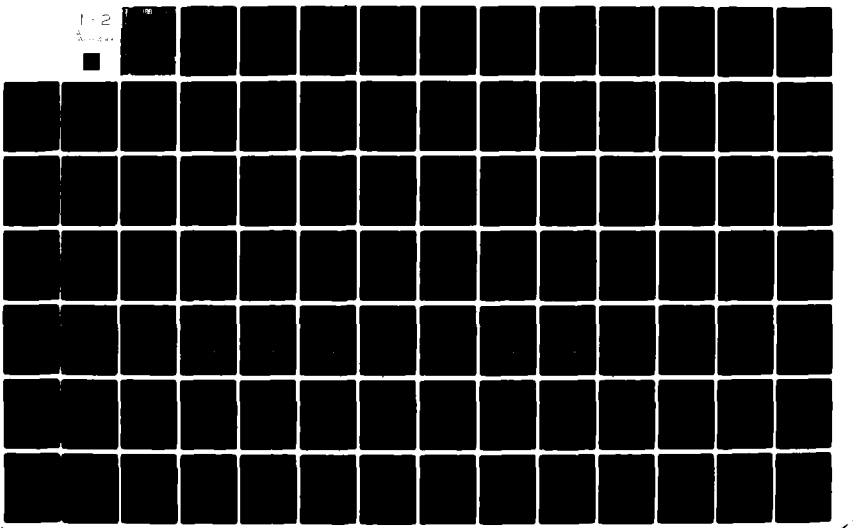
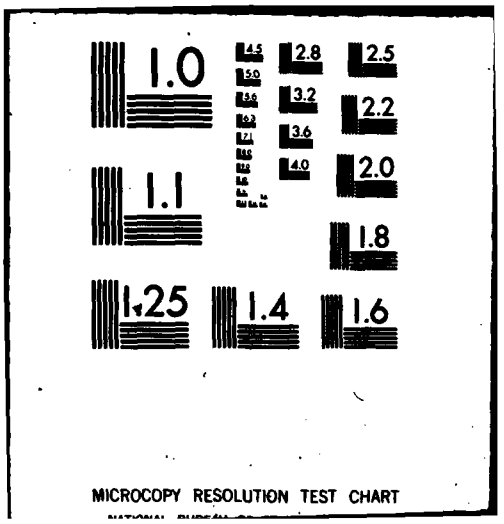
AD-A081 493 OGDEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT LAB--ETC F/G 21/9.2
PROPELLANT SURVEILLANCE REPORT LGM-30 A & B STAGE I TP-H1011.(U)
NOV 79 J A THOMPSON
UNCLASSIFIED MANCP-425(79) NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
MICROCOPY RESOLUTION TEST CHART

(14) MANCP [redacted]425(79)
MMWRM PROJECT M82934C-WNL17514

(6) # PROPELLANT SURVEILLANCE REPORT
LGM-30 A & B STAGE I
TP-H1011

Author

(10) John A. Thompson
JOHN A. THOMPSON, Chemist
Component & Combustion Test Unit

Engineering & Statistical Review By

John K Scambia
JOHN K. SCAMBIA, Project Engineer
Service Engineering

Edward J. Erickson
EDWARD J. ERICKSON, Statistician
Data Analysis Unit

Recommended Approval By

Ronald F. Larsen
RONALD F. LARSEN, Chief
Physical & Mechanical Test Unit

Leonidas A. Brown
LEONIDAS A. BROWN, Chief
Component & Combustion Test Unit

Approved By

Don F Woods
DON F. WOODS, Chief
Propellant Laboratory Section

(12) 110

(11) Nov[redacted]79

Industrial Products & Landing Gear Division
Directorate of Maintenance
Ogden Air Logistics Center
United States Air Force
Hill Air Force Base, Utah 84056

4/5/1987

ABSTRACT

This report contains propellant test results from cartons of TP-H1011 bulk propellant representing LGM-30 A and B First Stage Minuteman Motors. Testing was accomplished in accordance with MMWRM Project M82934C-WNL17514.

The purpose of testing was to determine and provide early warning of any serious degradation trends occurring in the propellant for service life predictions.

An analysis of all parameters indicates that no potential problems are expected in the propellant for at least two years past the oldest data point.

Data stored in the G085 System were plotted utilizing the IBM 360-65 Computer and CAL-COMP Plotter. The data range at any age can be found by suitable inquiry of the G085 System.

Each point on the regression plot represents the mean of all samples at that particular age. The number of specimens at each point is indicated on the sample size summary sheet accompanying each regression plot or group of regression plots.

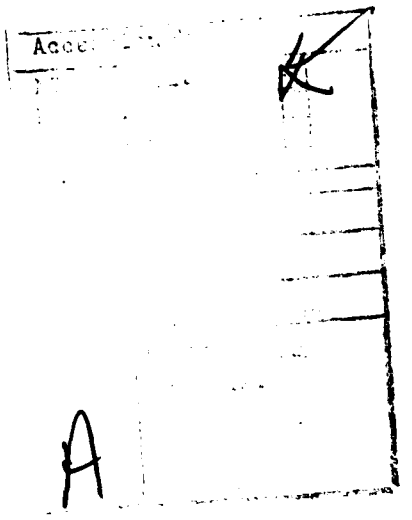


TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (cont)

LIST OF FIGURES (cont)

LIST OF REFERENCES

Report Nr	Title	Report Date
	LGM-30 First Stage, Wing I Test Reports	
29A	Test Report (Missile in silo)	13 Jan 64
29B	Zero Time Test Results	29 Jan 64
29C	Zero Time Test Results (Supplement 1)	30 Mar 64
29D	Zero Time Test Results (Aft Closure)	9 Jun 64
29E	Zero Time (Aft Closure Supplement 1)	24 Jun 64
29F	ATP Phase I Test Results	30 Mar 65
29G	ATP Phase I Test Results	19 Aug 65
29H	ATP Phase I Test Results	10 Sep 65
32A	Zero Time, Wings II-V Test Results	17 Mar 65
32B	Zero Time, Wings II-V Test Results (Aft Closure)	18 Mar 65
32C	ATP Phase I, Wings II-V Test Results	3 Nov 65
49	ATP Phase I, Wings II-V (First Group)	18 Mar 66
53	ATP Phase I, Wings II-V (Second Group)	22 Apr 66
55	ATP Phase I, Wings II-V (Third Group)	29 Apr 66
58	ATP Phase I, Wings II-V (Fourth Group)	6 May 66
61	ATP Phase I, Wings II-V (Fifth Group)	10 Jun 66
66	ATP Phase I, Wings II-V (Sixth Group)	22 Jul 66
76	ATP Phase II, Wing I Test Results	24 Jan 67
78	Zero Time, Wing VI Test Results	3 Feb 67
104	ATP Phase I, Wing VI (First Group)	12 Oct 67
118	ATP Phase II, Wings II-V (First Group)	5 Mar 68

LIST OF REFERENCES (CONT)

Report Nr	Title	Report Date
126	ATP Phase II, Wings II-V (Second Group	11 Apr 68
130	ATP Phase II, Wings II-V (Third Group)	3 May 68
162	ATP Phase I, Wing VI (Second Group)	30 Sep 69
176	ATP Phase II, Wing VI (First Group)	15 Apr 70
181	ATP Phase III, Wing I	7 May 70
185	ATP Phase I, Wing VI (Third Group)	22 Jun 70
195	ATP Phase III, Wings II-V (Retest)	29 Oct 70
223	Surveillance Report LGM-30 Stage I(TP-H1011)	Sep 71
239	Surveillance Report LGM-30 Stage I (TP-H1011 and TP-H1043)	Apr 72
258	Surveillance Report LGM-30 A & B Stage I (TP-H1011)	Nov 72
268	Surveillance Report LGM-30 A & B Stage I (TP-H1011	May 73
271	Surveillance Report LGM-30 F & G Stage I Phase A Series II, (TP-H1011)	Jul 73
277	Surveillance Report LGM-30 F & G Stage I Phase A Series III, (TP-H1011)	Oct 73
280	Surveillance Report LGM-30 A & B Stage I (TP-H1011)	Nov 73
288	Propellant Surveillance Report LGM-30 A & B, Stage I, TP-H1043	Mar 74
290	Propellant Surveillance Report LGM-30 F & G, Stage I, Phase B, Series I TP-H1011	Mar 74
300	Minuteman Stage I Motor Reliability Improvement Program Surveillance	May 74

LIST OF REFERENCES (CONT)

Report Nr	Title	Report Date
302	Propellant Surveillance Report LGM-30	Nov 74
313	Stage 1 Propellant Surveillance Report, Propellant Containing Glacial Acrylic Acid	Oct 74
315	Propellant Surveillance Report LGM-30 F & G Stage 1, TP-H1011	Jan 75
316	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Feb 75
319	Propellant Surveillance Report LGM-30 Dissected Motors, Phase VI, TP-H1011	Apr 75
321	Propellant Surveillance Report LGM-30 F & G Stage 1, Phase B, Series II, TP-H1011	Apr 75
325	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Jun 75
328	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Sep 75
330	Propellant Surveillance Report LGM-30 F & G Stage 1, TP-H1011	Oct 75
335	Stage 1 Motor Reliability Improvement Program	Dec 75
337	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1043	Feb 76
339	Stage 1, New MAPO & ERL-510 Qualification	Mar 76
341	Propellant Surveillance Report LGM-30 Dissected Motors, Phase VII, TP-H1011	Mar 76

LIST OF REFERENCES (CONT)

Report Nr	Title	Report Date
343	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1011	Jun 76
345	Propellant Surveillance Report LGM-30 F & G, Stage 1 Phase B, Series III, TP-H1011	Jun 76
350	Qualification of a New MAPO Source and ERL-510 Curing Agent for Minuteman, Stage 1, UF-2121 Liner	Sep 76
351	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1011	Sep 76
354	Minuteman Stage 1 Motor Reliability Improvement Program Surveillance	Sep 76
358	Propellant Surveillance Report LGM-30 Dissected Motors, Phase VIII, TP-H1011	Oct 76
360	Propellant Surveillance Report LGM-30 F & G, Stage 1 Phase E, Series III, TP-H1011	Nov 76
367	Propellant Surveillance Report LGM-30 A & B, Stage 1, TP-H1011	Apr 77
370	Propellant Surveillance Report LGM-30 F & G, Stage 1, Phase E, Series II, TP-H1011	Apr 77
377	Qualification of a New MAPO Source and ERL-510 Curing Agent for Minuteman Stage 1, UF-2121 Liner	Oct 77
379	Final RIP Report, Minuteman Stage 1 Motor Reliability Improvement Program Surveillance	Oct 77
385	Propellant Surveillance Report LGM-30 A, B, F, & G, Stage 1, TP-H1043	Dec 77
388	Propellant Surveillance Report LGM-30 A & B Stage 1, TP-H1011	Jan 78
390	Propellant Surveillance Report LGM-30 F & G Stage 1, Phase E, Series IV, TP-H1011	Feb 78
392	Propellant Surveillance Report LGM-30 Dissected Motors, Phase IX, TP-H1011	Mar 78
393	Propellant Surveillance Report LGM-30 A & B Stage I, TP-H1011	May 78

LIST OF REFERENCES (CONT)

Report Nr	Title	Report Date
396	Propellant Surveillance Report LGM-30 F & G Stage I, TP-H1011	Jun 78
405	Propellant Surveillance Report LGM-30 F & G Stage I, TP-H1011	Oct 78
406	Propellant Surveillance Report LGM-30 Dissected Motors, Phase X, TP-H1011	Nov 78
416	Propellant Surveillance Report LGM-30 F and G Stage I, TP-H1011	Apr 79
423	Propellant Surveillance Report LGM-30 F and G Stage I, TP-H1011	Oct 79

GLOSSARY OF TERMS AND ABBREVIATIONS

Aging Trend	A change in properties or performance resulting from aging of material or component
CSA	Cross Sectional Area
DB	Dogbone
Degradation	Gradual deterioration of properties or performance
E	Modulus (psi), defined as stress divided by strain along the initial linear portion of the curve.
EB	End Bonded
EGL	Effective Gage Length
em	Strain at maximum stress
er	Strain at rupture
"F" ratio	The ratio of the variance accounted for by the regression function to the random unexplained variance. The regression function having the most significant "F" ratio is used for plotting data. The ratio is also used in detecting significant changes in random variation between succeeding time points
JANNAF	Joint Army, Navy, NASA, Air Force
MANCP	Propellant Lab Section at Ogden Air Logistics Center
Ogden ALC	Ogden Air Logistics Center, Air Force Logistics Command
r or R	The Correlation Coefficient is a measure of the degree of closeness of the linear relationship between two variables
Regression Equation	The general form of the regression equation is $Y = a + bx$
Regression Line	Line representing mean test values with respect to time
S_b	Standard error of estimate of the regression coefficient

GLOSSARY OF TERMS AND ABBREVIATIONS (cont)

S_e or $S_{Y.X}$	Standard deviation of the data about the regression line
Sm	Maximum Stress
Sr	Stress at rupture
Standard Deviation (S_y)	Square root of variance
Strain Rate	Crosshead speed divided by the EGL
"t" test	A statistical test used to detect significant differences between a measured parameter and an expected value of the parameter (determines if regression slope differs from zero at the 95% confidence level)
Variance	The sum of squares of deviations of the test results from the mean of the series after division by one less than the total number of test results
3 Sigma Band	The area between the upper and lower 3 sigma limit. It can be expected that 99.73% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed.
90-90 Band	It can be stated with 90% confidence that 90% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed

INTRODUCTION

A. PURPOSE:

Quality assurance tests have been conducted for sixteen ½ years on First Stage LGM-30A and B Minuteman Motor Propellant blocks to evaluate the effects of aging on TP-H1011 propellant.

Statistical analysis of the tests performed, as directed by Engineering, should provide early warning if serious degradation trends occur. Annual evaluation of the propellant provide data that can be directly input into engineering reliability and service life predictions. Testing was performed in accordance with MMWRM Directive GTD-1C and GTD-1C Amendments 1 and 2.

B. BACKGROUND:

Testing was first accomplished at MANCP on LGM-30A TP-H1011 propellant blocks in 1963 and was designated Zero-Time Testing (MAGCP Report Nrs 29B, 29C and 29F). Subsequent testing was accomplished at approximately 24 month intervals (MAGCP Report Nrs 29G, 29H - Phase I; 76 - Phase II; 181 - Phase III).

LGM-30B Zero-Time testing was accomplished in 1964 with subsequent testing at intervals of 24 months (MAGCP Report Nrs 32A-Zero-Time; 32C, 49, 53, 55, 58, 61, 66 - Phase I: 118, 126, 130-Phase II; 195, 268 - Phase III).

Reports prior to MAGCP Report Nr 223(72) contained raw data using sigma relation to compare to Zero-Time variance. MANCP Report Nr 239(72) published in April of 1972 contained all the

data on LGM-30 A, B, F and G in the G085 System at that time. Report Nrs. 258(72) and 268(73) reported LGM-30 A and B data in statistical analysis by itself. This report is the tenth time that LGM-30 A and B data have been reported in this manner.

Zero time testing was started as soon as possible after receipt of the propellant by MANCP. Data from these tests were used to establish a base line for each test to which each subsequent test data (ATP - Accelerated Test Program) were compared in the reports listed above.

The LGM-30 A and B test matrix (Table 1) was used to determine the number of specimens to be taken from each propellant loaf and the specific test or tests to which these specimens were subjected. Low rate tensile and hardness specimens were taken from all LGM-30 A and B blocks. Specimens for other physical and combustion tests were taken from every seventh block.

The testing program has been revised over the years. Some tests have been added later in the program. Therefore, early test data in the 0 - 6 year period may not always be available for inclusion in a particular regression analysis.

Table 1

Test Program

The test matrix is taken from GTD-1C, Amendment 2, and the tests, conditions, number of specimens and test methods are listed below.

Test	Conditions	Description	Per Cond
Hardness	10 Sec	Dogbone Ends	3
Low Rate Tensile	2.0 in/min	1/2" JANNAF Dogbone	3
High Rate Tensile	1750 in/min	3/4" Dogbone	3
High Rate Triaxial Tensile	600 psi, 1750 in/min	3/4" GL Rail End Bonded	1
Low Rate Biaxial Tensile	0.2 in/min	3/4" GL Rail End Bond	1
Stress Relaxation	3% & 5%	1/2" x 1/2" x 4" EB	3
Dynamic Response	70 gm ct wt	3.3" dia x .33" disc	1
Sol Gel		1/2" x 1/2"	8
VLR	2×10^{-3} in/min	1/2" JANNAF Dogbone	3
Ignitability	168 cal/cm^2 sec	.050" wafer	3
TCLE		.200" wafer	3
Pressure Time	500 psi	1/2" x 3/8" x 1"	3
Burning Rate	1000 psi	.156" x .156" x 5" Strand	3
DTA	12°C Rise/min	.040" wafer	3
DSC		.040" wafer	3
Poisson's Ratio	77°F $\pm$ 2° 15% Strain	.50" x .50" x 4"	6
Tear Energy	70°F $\pm$ 2°	0.1" x 1.18" x 3"	6
Failure Envelope		JANNAF Dogbone	3

STATISTICAL APPROACH

In order to determine aging trends for shelf/service life predictions, as directed by Service Engineering, First Stage LGM-30 A and B Minuteman Motor propellant (TP-H1011) blocks have been under-going testing since 1963, statistically analyzed and reported on a regular test cycle by this laboratory.

The primary reason for performing statistical analysis on test data is for the detection of propellant changes due to aging that would affect motor reliability. Regression analysis was the method used to examine data and to aid in drawing conclusions about dependency relationships that may exist i.e., relationship between age versus test results.

The linear model ($Y = a + bX$) was found to be the best fit model for almost all regressions within this report. The only exception was for the test parameter pressure time at maximum pressure. For this parameter the reciprocal of X ($Y = a + b\ (1/X)$) proved to be the best fit model.

Individual data points from different time periods were used to establish a least squares trend line for the data. The variance about the regression line, obtained using individual values of the dependent variable, was used to compute a tolerance interval such that at the 90% confidence level 90% of the sample distribution falls within this interval. This tolerance interval was extrapolated to a maximum of 24 months into the future from the age of the oldest motor tested. The 't' values and the significance of this statistic, which are reported for each regression model, give an indication of the 'statistical significance' of the slope of the trend line as compared to a line of zero slope.

Data were plotted by computer. The 'y' axis is computed so that the values at one inch intervals are peculiar to the data spread of the parameter tested. Plotted data points represent means at the particular ages at which testing occurred. The number of specimens at each age point is indicated on the sample size summary sheet accompanying each regression plot or group of regression plots. Variance at each test age can be determined by consulting the G085 data storage system.

In a few cases, a small change has become apparent in data variance and regression trend lines. However, the changes are gradual and no operational problems are expected at this time.

A small post-cure effect (propellant properties are affected by curing reactions during the first year or two after manufacture) has been observed on some of the earliest test data. This curing effect tends to bias and skew the projected trend lines. To reduce this bias, some of the earliest data has been deleted from the regressions. As the data from the total sample population increases in size, this deleted data causes no problems. By compensating for this post-cure biasing, a more accurate aging trend line for service life prediction is provided.

TEST RESULTS

A. TENSILE:

Regressions for very low rate tensile data show a statistically significant decrease in the strain parameters. The stresses and modulus regressions show a statistically significant increase (Figures 1 thru 5).

Low rate strain regressions show a statistically significant decrease. The stresses and modulus regressions show a statistically significant increase (Figures 6 thru 10).

For low rate biaxial tensile testing the strains do not show a significant trend. The stresses and modulus regressions show a statistically significant increase (Figures 11 thru 15).

The high rate tensile strain at maximum stress shows a statistically significant increase. Maximum stress has a non-significant aging trend. Strain at rupture shows a statistically significant decrease. Stress at rupture and modulus show a statistically significant increase (Figures 16 thru 20). The large variation in data points for modulus at 12 to 16 1/2 years is mostly due to a reduced number of specimens tested per month.

For triaxial tensile testing, the strains and stresses show a statistically significant increase. Modulus shows a statistically significant decrease (Figures 21 thru 25).

For all of the tensile testing, where changes are shown, the trends are gradual and no operational problems are expected for at least two years beyond the oldest data point.

B. STRESS RELAXATION:

Modulus at both 3% and 5% strains show a statistically significant increase for all time periods (Figures 26 thru 33). However, the slopes of the trend lines are gradual and no operational problems with the propellant are expected.

C. DYNAMIC RESPONSE:

The storage shear modulus at 200 and 400 Hz shows a statistically significant decrease while the loss tangent at 200 and 400 Hz shows a statistically significant increase (Figures 34 thru 37).

D. CONSTANT STRAIN:

Strain at rupture for constant strain does not show a significant change (Figure 38).

E. TCLE (THERMAL COEFFICIENT OF LINEAR EXPANSION):

The thermal coefficient of linear expansion below and above the glass transition point shows a statistically significant increase (Figures 39 and 40).

F. SOL GEL:

The cross link density shows a statistically significant increase with a statistically significant decrease for percent extractables and

for weight swell ratio a non-significant change (Figures 42 thru 43).

The increasing cross link density trend correlates well with the other physical properties. The tensile testing shows an increase in maximum stress and modulus with strains decreasing. The stress relaxation, dynamic response and constant strain results also correlates well with cross link density.

G. DTA (DIFFERENTIAL THERMAL ANALYSIS):

For the DTA regressions the endotherm and first and second exotherms show a statistically significant decrease. The third exotherm shows a statistically significant increase. There is no significant change for ignition temperature (Figures 44 thru 48).

H. PRESSURE TIME:

Maximum pressure shows a statistically significant decrease and the time to maximum pressure shows a statistically significant increase (Figures 49 and 50).

I. BURNING RATE:

The burning rate shows a statistically significant decrease (Figure 51). This correlates with the increasing time to maximum pressure.

J. IGNITABILITY:

Ignitability shows no significant change (Figure 52).

K. DSC (DIFFERENTIAL SCANNING CALORIMETER):

The endotherm, first and second exotherm show no significant changes (Figures 53 thru 55).

L. TGA (THERMALGRAVIMETRIC ANALYSIS):

The percent weight loss at ignition, ignition temperature, and percent weight loss at 250°C hold, all show a statistically significant increase (Figures 56 thru 58).

In general, where statistically significant changes are shown for the thermal analysis the trends are gradual. From this it is concluded that the propellant will remain thermally stable for at least two years beyond the last data point.

CONCLUSIONS

This report includes LGM-30 A and B bulk propellant test results presently in the G085 System and covers the past sixteen and one-half years of testing.

The test results show that under present storage conditions the physical/mechanical and combustion properties of the propellant are remaining relatively stable with age. This is indicated by the regression plots where the slope of the trend line is relatively flat or close to a line of zero slope and have not changed appreciably from the last test period.

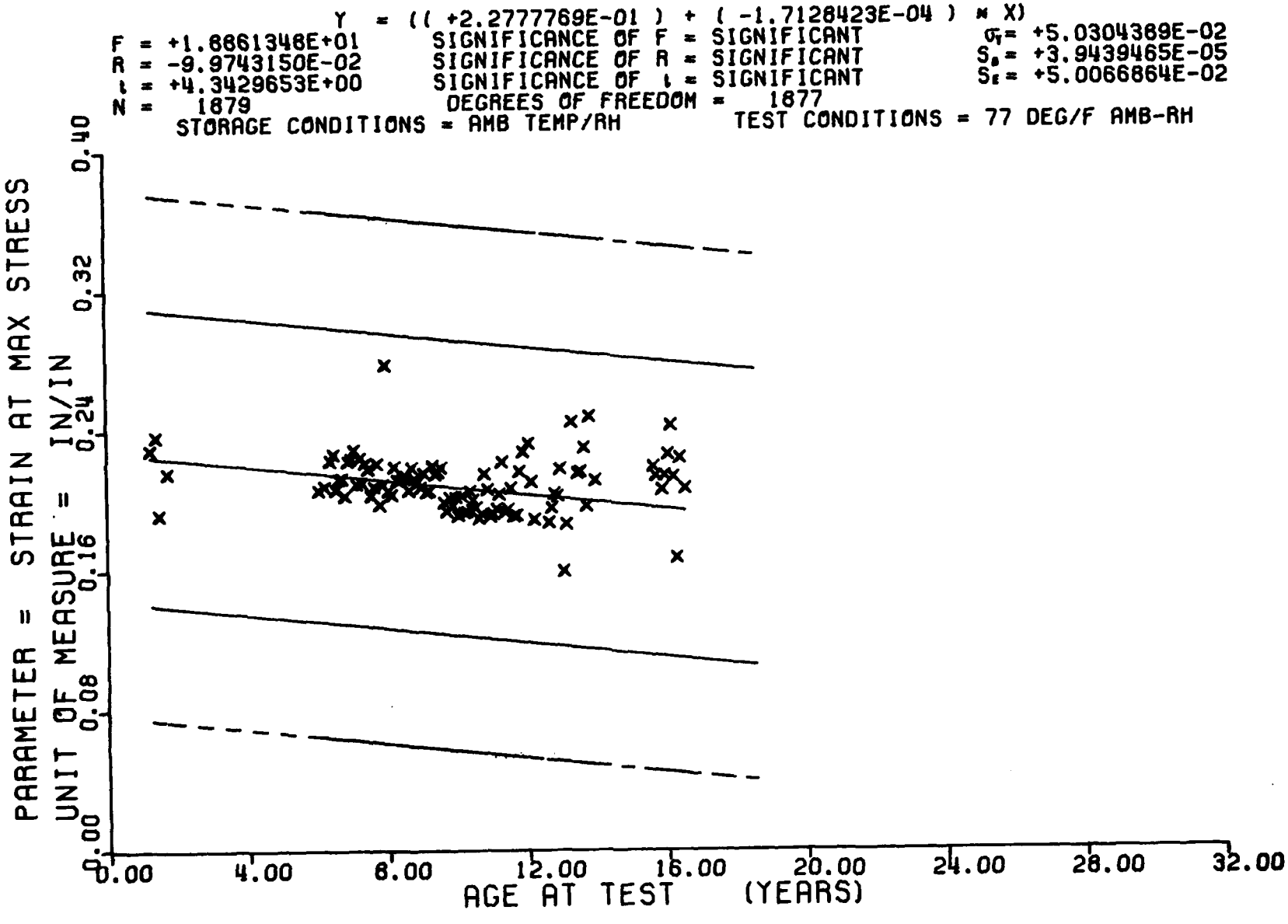
From the statistical analyses, all tests conducted indicate that motor propellant reliability will not be affected for at least two years past the last data point on the regression.

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
15	18	96	29	121	24	147	3
17	21	97	34	122	21	152	6
18	6	98	38	123	19	153	24
21	6	99	33	124	20	154	12
73	9	100	34	125	18	155	21
75	18	101	24	126	51	156	5
77	18	102	22	127	26	157	4
78	3	103	40	128	42	158	3
79	9	104	20	129	28	160	6
80	30	105	39	130	18	162	6
81	18	106	28	131	25	163	6
82	9	107	28	132	24	164	3
83	18	108	44	133	20	165	3
84	18	109	22	134	39	166	3
85	6	110	26	135	45	168	6
86	40	111	24	136	18	188	3
87	27	112	29	137	39	189	1
88	23	113	41	138	21	191	11
89	13	114	15	139	12	192	10
90	7	115	16	140	24	193	9
91	15	116	27	141	33	194	3
92	7	117	12	142	21	195	6
93	12	118	33	143	6	196	3
94	19	119	27	145	3	197	6
95	22	120	36	146	3	199	3

STAGE 1,WING 162 VERY LOW RATE CHS=0.002 IN/MIN STRAIN AT MAX STRESS (EM)

This sample size summary is applicable to figures 1 thru 5



STAGE 1,WING 1&2 VERY LOW RATE CHS=0.002 IN/MIN STRAIN AT MAX STRESS (EM)

Figure 1

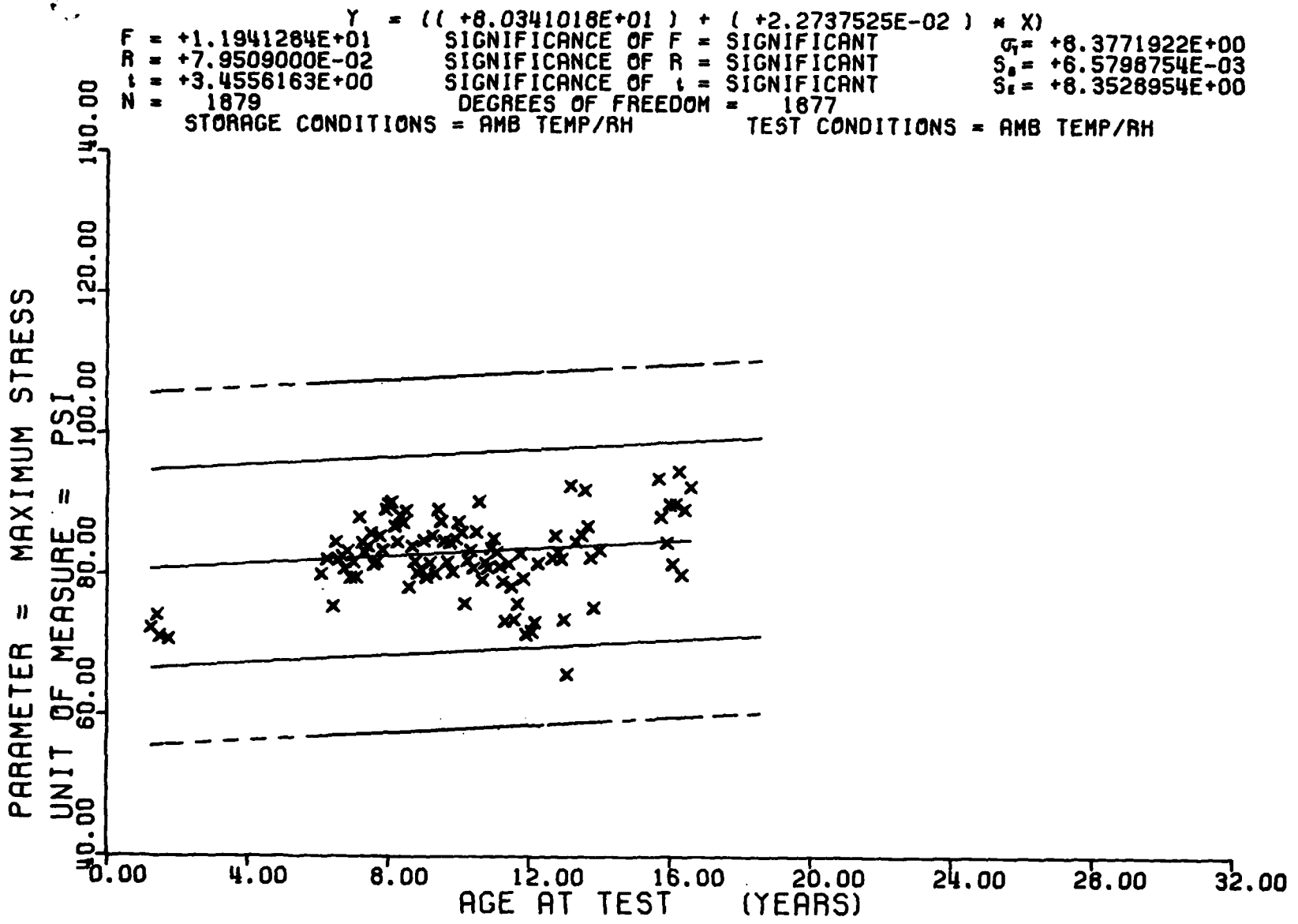
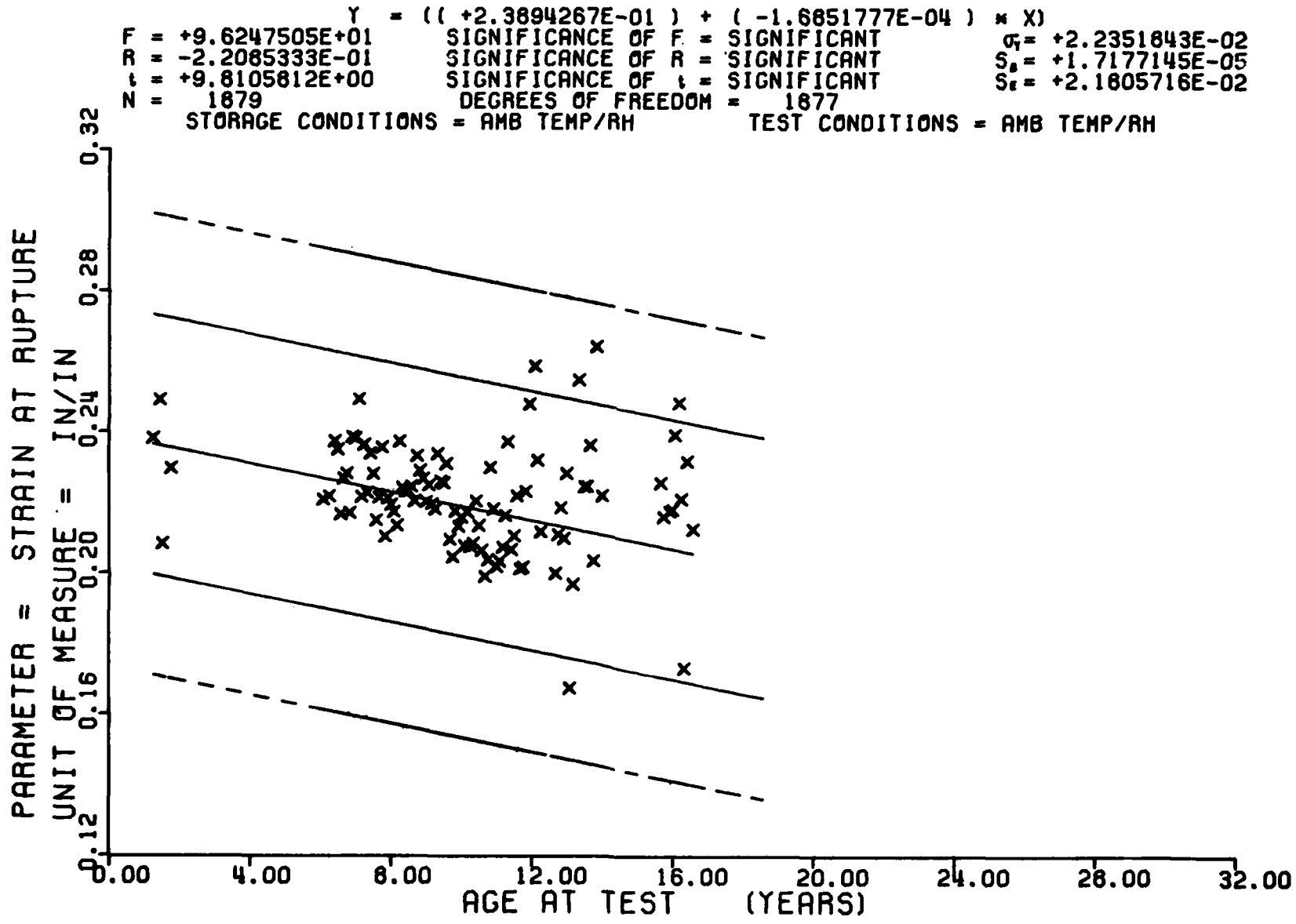

Y = ((+8.0341018E+01) + (+2.2737525E-02) * X)
F = +1.1941284E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = +7.9509000E-02 SIGNIFICANCE OF R = SIGNIFICANT
t = +3.4556163E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 1879 DEGREES OF FREEDOM = 1877
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
40.00
60.00
80.00
100.00
120.00
140.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 VERY LOW RATE CHS=0.002 IN/MIN MAXIMUM STRESS (SM)

Figure 2



STAGE 1,WING 1&2 VERY LOW RATE CHS=0.002 IN/MIN STRAIN AT RUPTURE (ER)

Figure 3

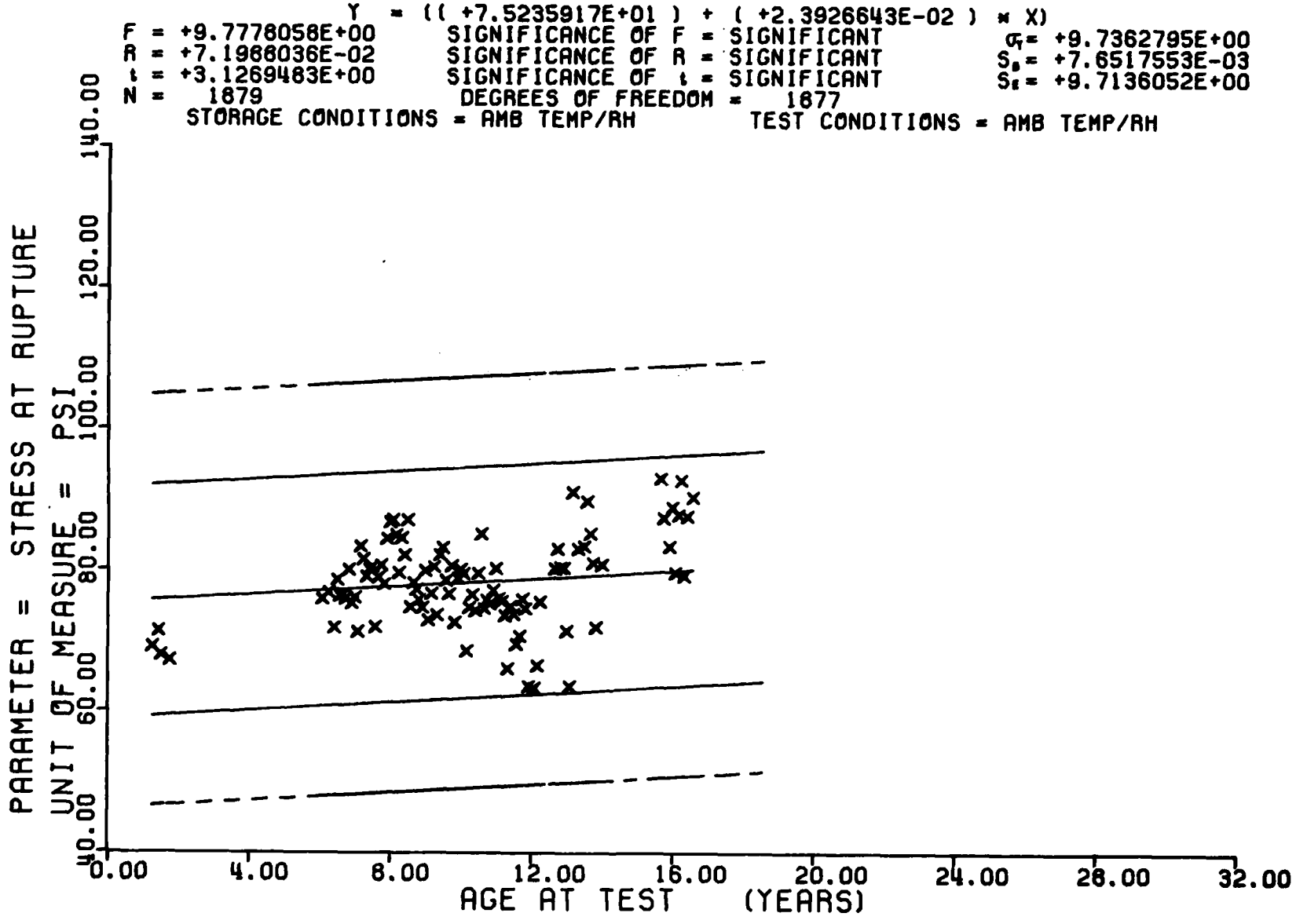
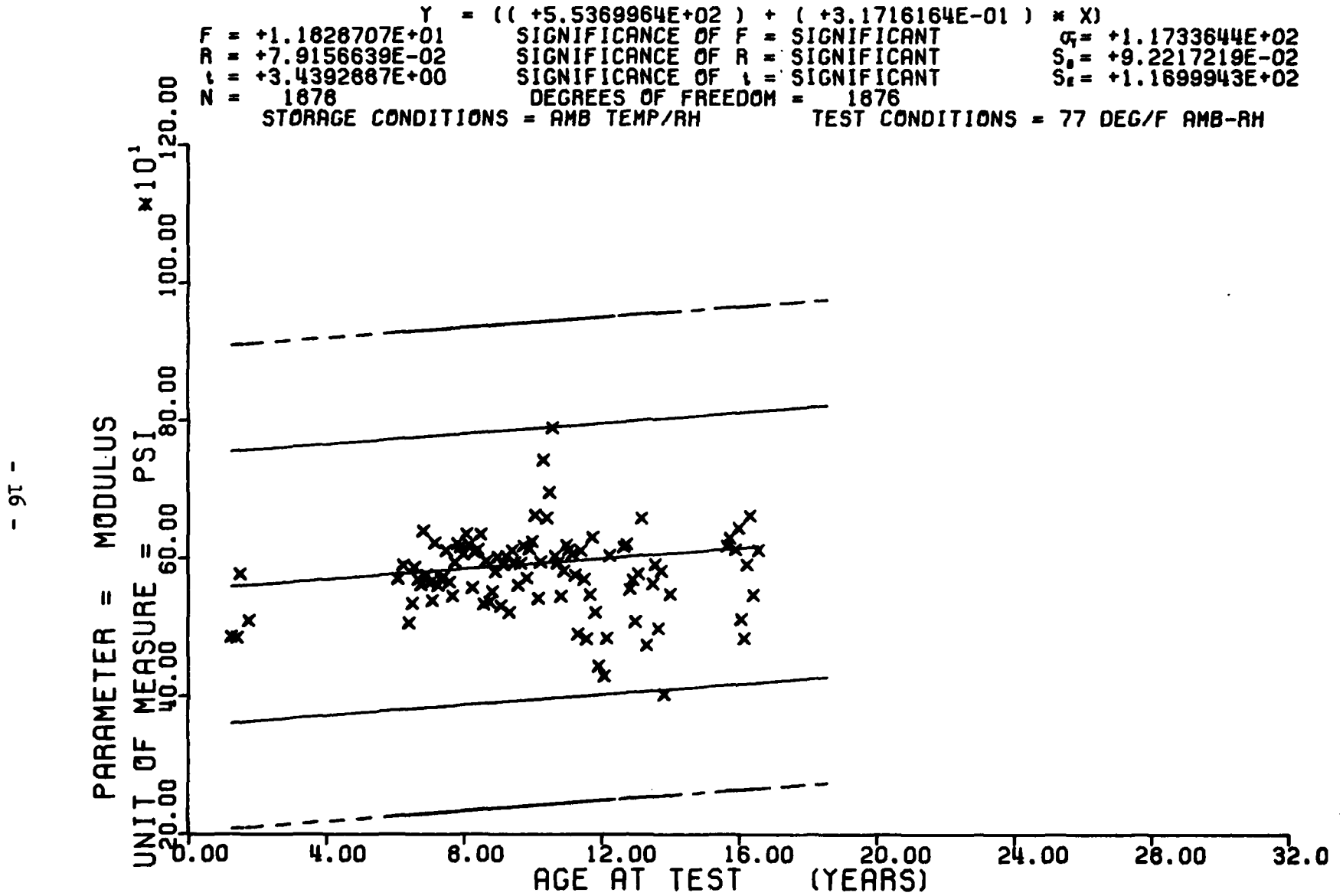

Y = ((+7.5235917E+01) + (+2.3926643E-02) * X)
F = +9.7778058E+00 SIGNIFICANCE OF F = SIGNIFICANT
R = +7.1966036E-02 SIGNIFICANCE OF R = SIGNIFICANT
t = +3.1269483E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 1879 DEGREES OF FREEDOM = 1877
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
σt = +9.7362795E+00
Sb = +7.6517553E-03
Sε = +9.7136052E+00
PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI
140.00
120.00
100.00
80.00
60.00
40.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 142 VERY LOW RATE CHS=0.002 IN/MIN STRESS AT RUPTURE (SR)

Figure 4



STAGE 1,WING 142 VERY LOW RATE CHS=0.002 IN/MIN MODULUS (E)

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
1	1	30	392	55	24	81	156	106	274	131	191
6	5	31	307	56	18	82	260	107	153	132	220
7	33	32	215	57	30	83	166	108	257	133	158
8	53	33	114	58	24	84	182	109	182	134	215
9	49	34	91	59	24	85	308	110	165	135	282
10	89	35	57	60	42	86	144	111	171	136	264
11	40	36	63	62	24	87	472	112	322	137	198
12	46	37	56	63	51	88	683	113	155	138	135
13	44	38	75	64	81	89	783	114	213	139	168
14	65	39	68	65	42	90	505	115	193	140	76
15	43	40	54	66	96	91	558	116	204	141	196
16	69	41	84	67	39	92	528	117	220	142	97
17	42	42	215	68	69	93	297	118	229	143	33
18	75	43	242	69	100	94	365	119	162	144	45
19	127	44	158	70	89	95	310	120	188	145	27
20	65	45	194	71	165	96	212	121	238	146	3
21	85	46	136	72	142	97	144	122	74	147	39
22	51	47	53	73	99	98	235	123	174	148	3
23	90	48	36	74	133	99	215	124	160	150	3
24	341	49	27	75	252	100	210	125	198	151	6
25	209	50	17	76	153	101	186	126	170	152	36
26	251	51	16	77	157	102	174	127	183	153	182
27	391	52	21	78	153	103	177	128	156	154	110
28	353	53	6	79	134	104	151	129	186	155	117
29	517	54	3	80	194	105	217	130	160	156	59

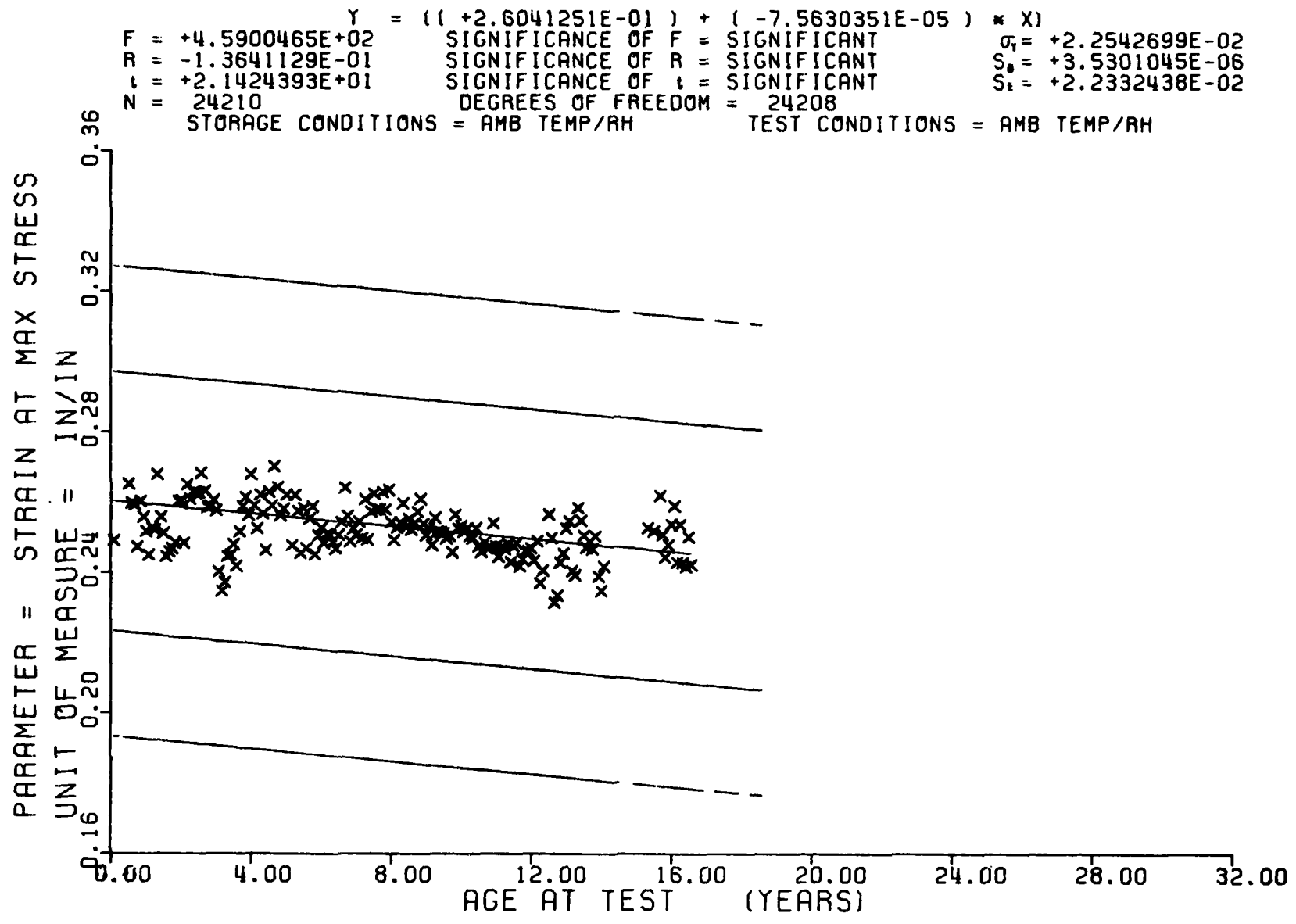
STAGE 1.WING 1&2 LOW RATE TENSILE CHS=2.0 IN/MIN STRAIN AT MAX STRESS (EM)

This sample size summary is applicable to figures 6 thru 10

*** SAMPLE SIZE SUMMARY ***

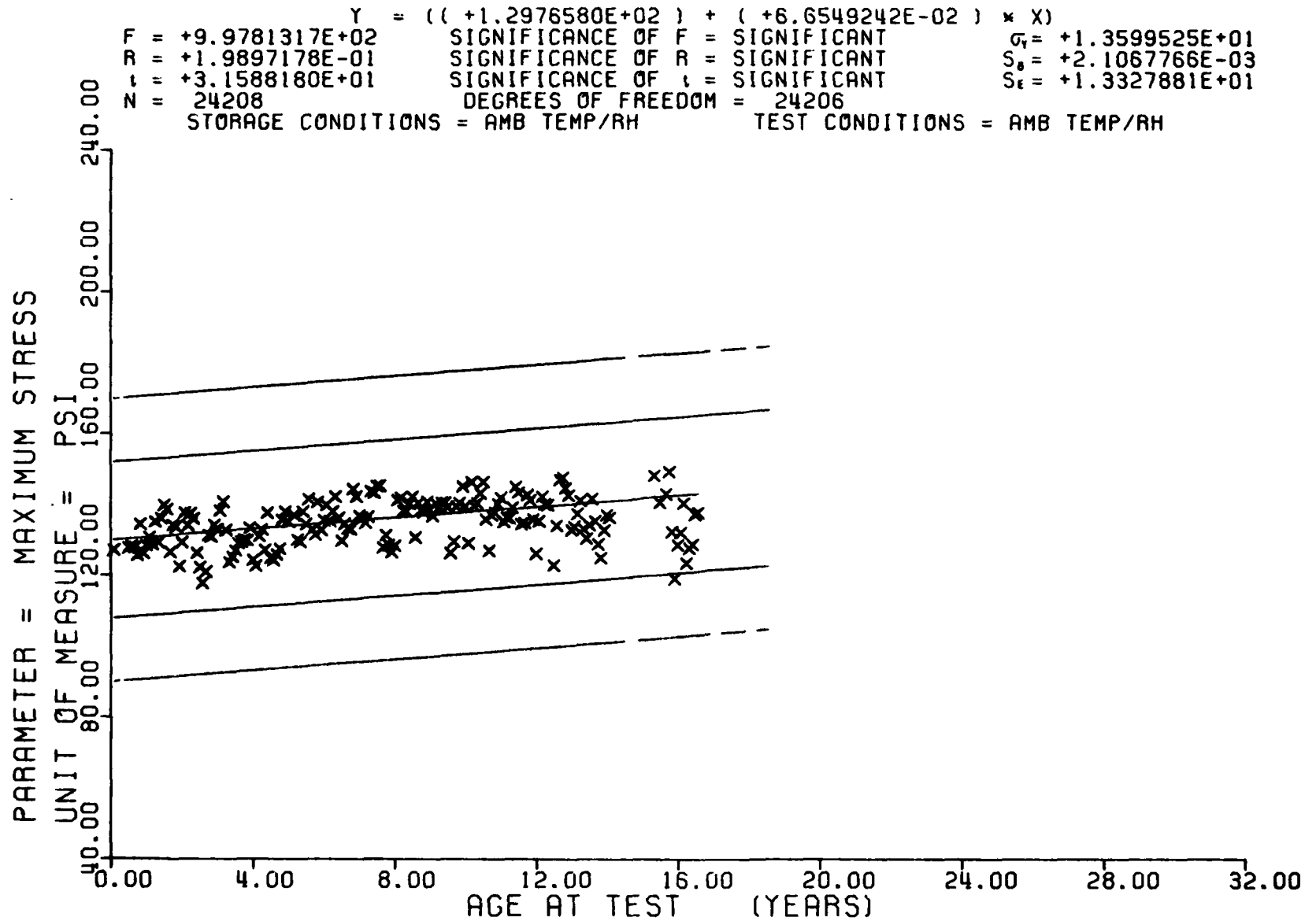
AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
157	69	198	9
158	9	199	9
159	3		
160	24		
161	15		
162	12		
163	39		
164	27		
165	24		
166	30		
167	21		
168	21		
169	9		
184	6		
186	9		
188	9		
189	18		
190	12		
191	108		
192	71		
193	96		
194	30		
195	28		
196	39		
197	12		

STAGE 1.WING 162 LOW RATE TENSILE CHS=2.0 IN/MIN STRAIN AT MAX STRESS (EM)



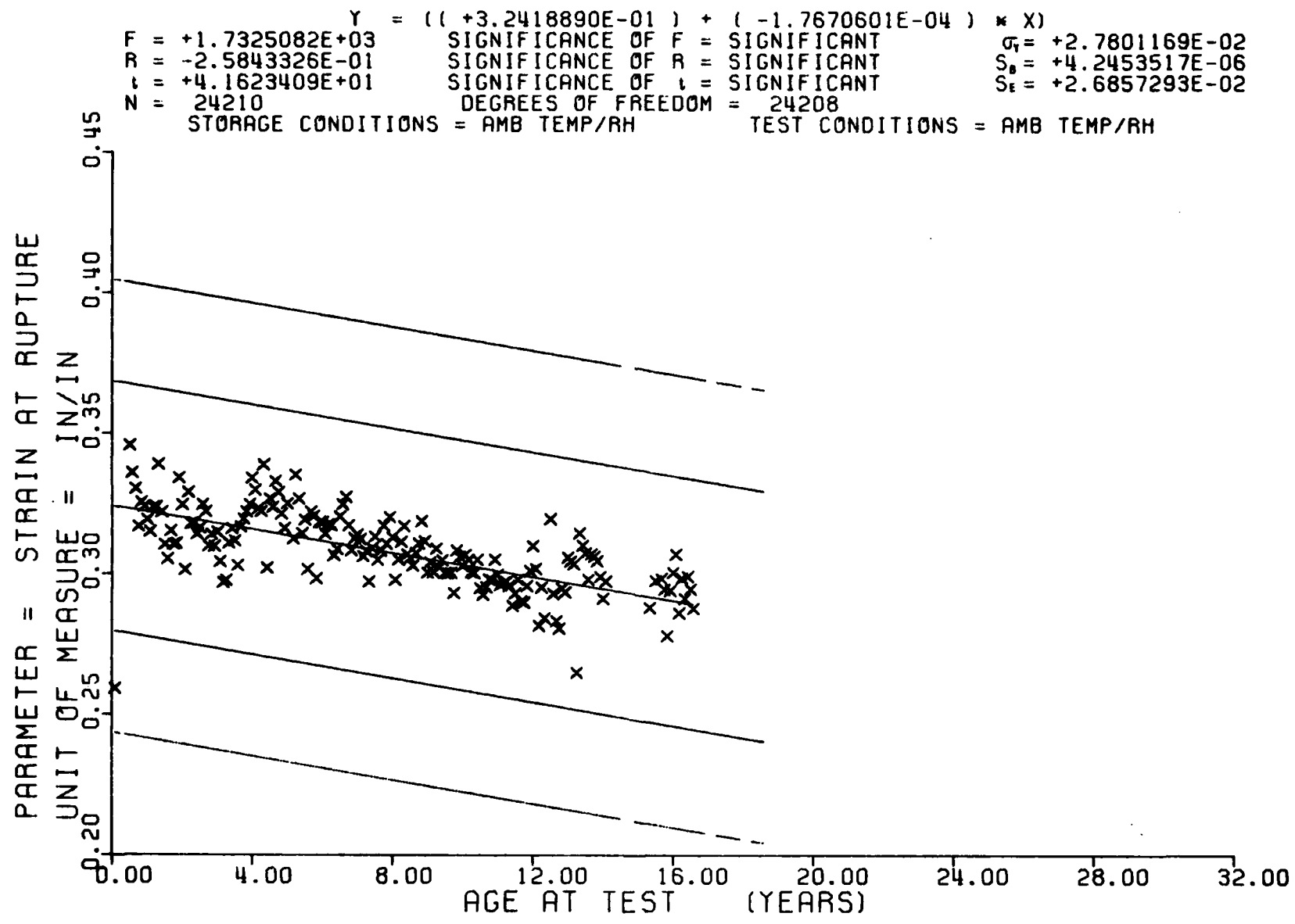
STAGE 1,WING 1&2 LOW RATE TENSILE CHS=2.0 IN/MIN STRAIN AT MAX STRESS (EM)

Figure 6



STAGE 1,WING 1&2 LOW RATE TENSILE CHS=2.0 IN/MIN MAXIMUM STRESS (SM)

Figure 7



STAGE 1,WING 1&2 LOW RATE TENSILE CHS=2.0 IN/MIN STRAIN AT RUPTURE (ER)

Figure 8

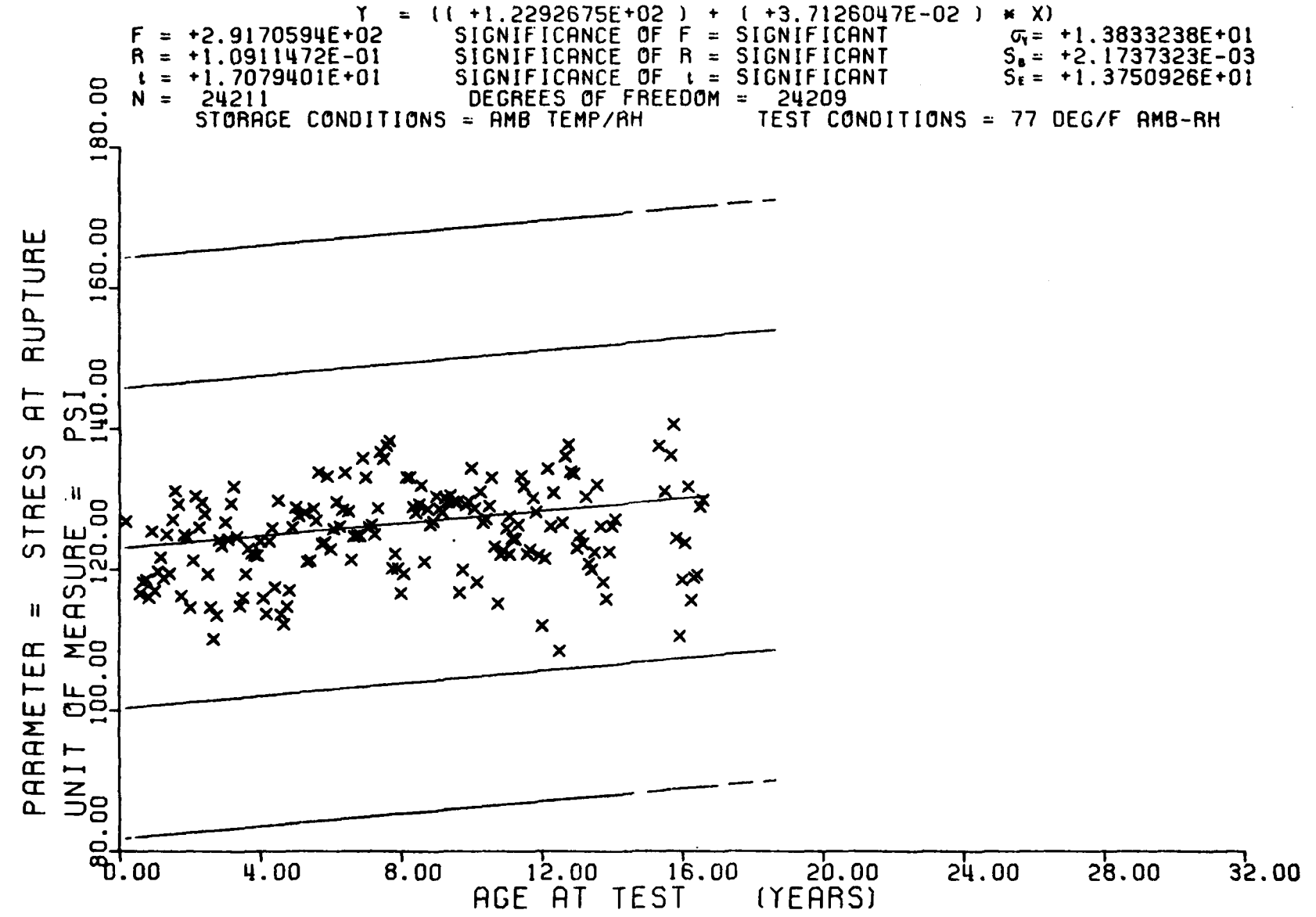
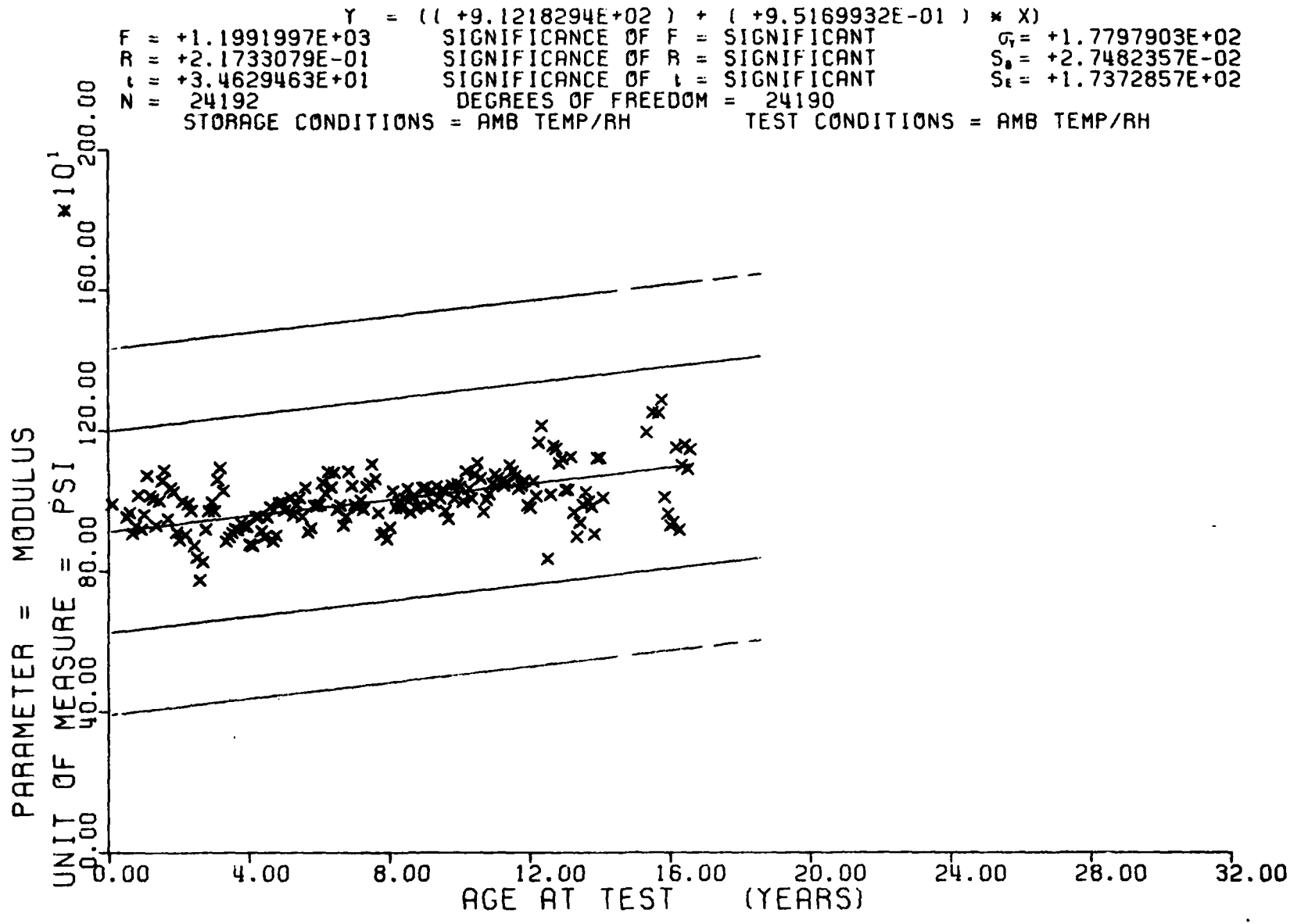

Y = ((+1.2292675E+02) + (+3.7126047E-02) * X)
F = +2.9170594E+02 SIGNIFICANCE OF F = SIGNIFICANT σ = +1.3833238E+01
R = +1.0911472E-01 SIGNIFICANCE OF R = SIGNIFICANT S = +2.1737323E-03
t = +1.7079401E+01 SIGNIFICANCE OF t = SIGNIFICANT S = +1.3750926E+01
N = 24211 DEGREES OF FREEDOM = 24209
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 77 DEG/F AMB-RH
PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI
180.00
160.00
140.00
120.00
100.00
80.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 LOW RATE TENSILE CHS=2.0 IN/MIN STRESS AT RUPTURE (SR)

Figure 9



STAGE 1,WING 1&2 LOW RATE TENSILE CHS=2.0 IN/MIN MODULUS (E)

Figure 10

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
6	3	31	18	58	2	85	11	110	8	135	13
7	4	32	8	60	1	86	18	111	12	136	16
8	2	33	7	62	2	87	11	112	10	137	10
9	5	34	12	63	1	88	14	113	8	138	8
10	4	35	11	64	1	89	26	114	6	139	1
11	7	36	10	65	1	90	34	115	11	140	2
12	7	37	4	66	2	91	23	116	5	141	9
13	6	38	10	67	2	92	37	117	8	142	5
14	7	39	5	68	1	93	30	118	5	148	1
15	10	40	11	69	2	94	20	119	4	152	1
16	7	41	3	70	2	95	11	120	12	153	5
17	5	43	5	71	4	96	10	121	11	154	3
18	7	44	20	72	3	97	9	122	16	155	5
19	10	45	35	73	9	98	1	123	6	156	6
20	10	46	32	74	4	99	3	124	13	157	12
21	19	47	31	75	5	100	5	125	9	158	6
22	12	48	8	76	9	101	2	126	11	161	2
23	13	49	9	77	12	102	4	127	6	163	1
24	29	50	7	78	7	103	4	128	8	164	3
25	35	51	3	79	16	104	9	129	7	165	1
26	32	52	1	80	5	105	9	130	7	166	3
27	27	53	2	81	10	106	9	131	4	169	1
28	49	54	9	82	15	107	10	132	4	189	2
29	30	55	7	83	13	108	11	133	4	190	2
30	37	56	4	84	10	109	12	134	6	191	8
										192	5
										193	13
										194	1
										195	2
										196	4

STAGE 1.WING 162 LOW RATE BIAXIAL CHS=0.2 IN/MIN STRAIN AT MAX STRESS (EM)

This sample size summary is applicable to figures 11 thru 15

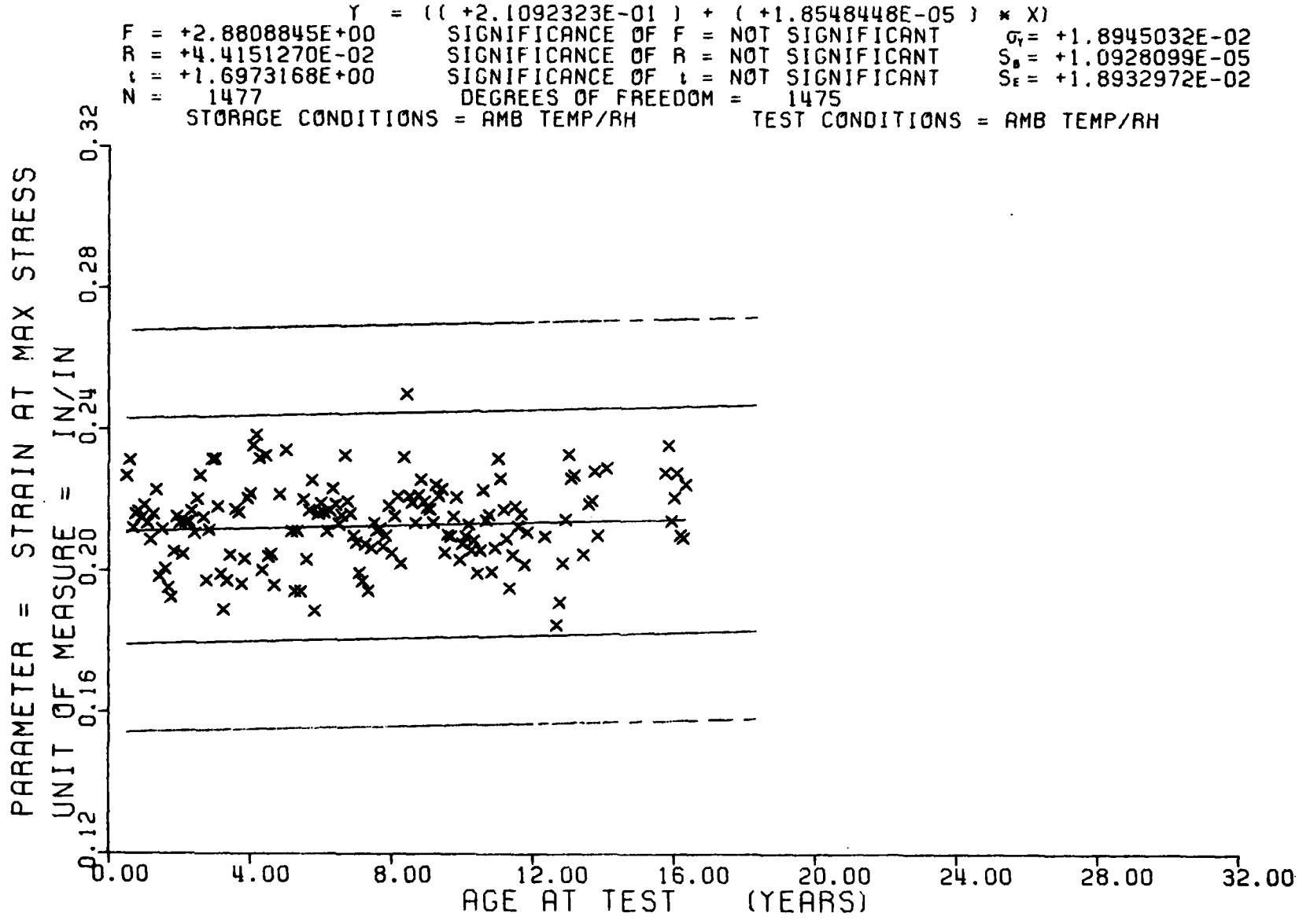
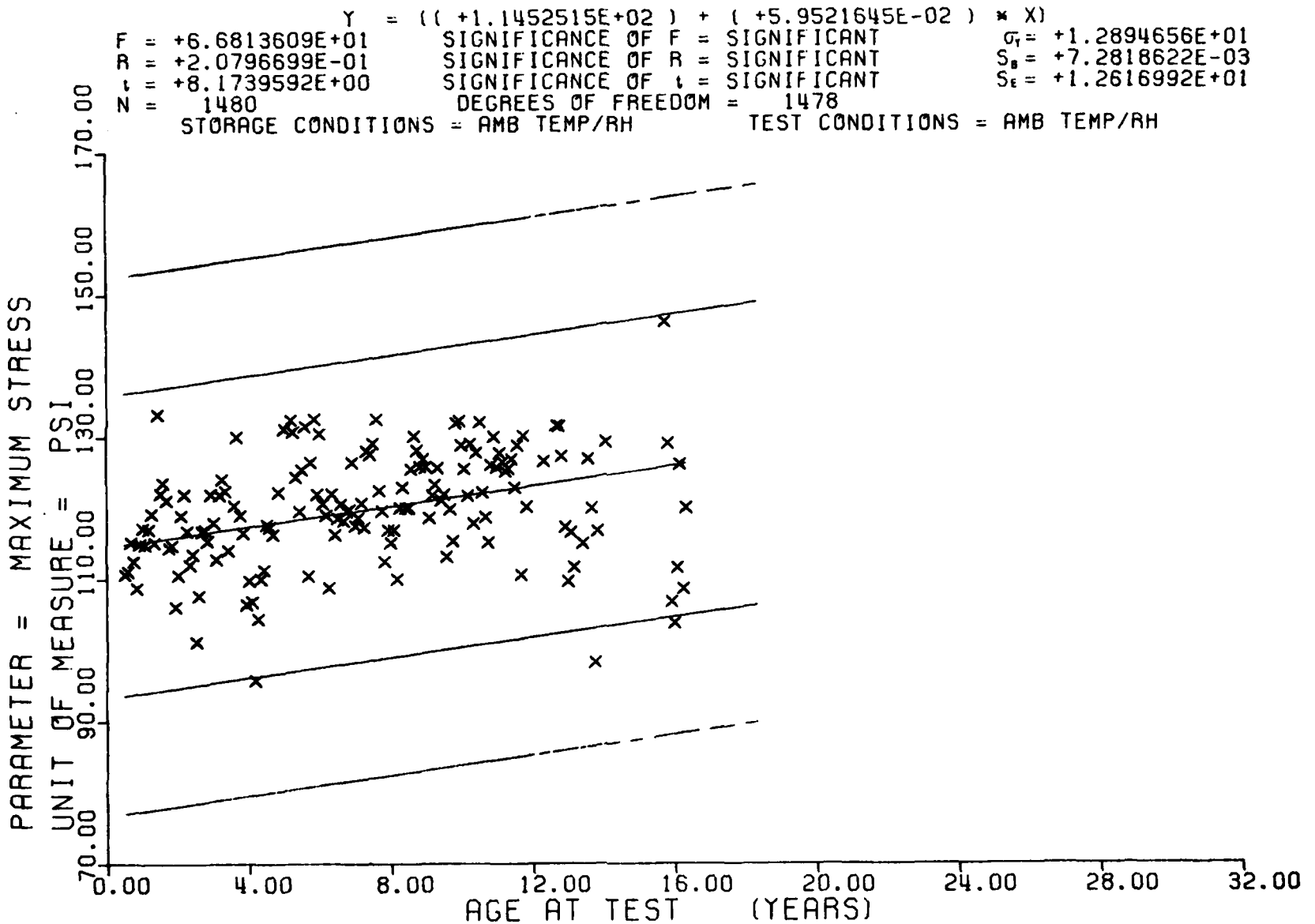

Y = ((+2.1092323E-01) + (+1.8548448E-05) * X)
F = +2.8808845E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σY = +1.8945032E-02
R = +4.4151270E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT Sβ = +1.0928099E-05
t = +1.6973168E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT Sε = +1.8932972E-02
N = 1477 DEGREES OF FREEDOM = 1475
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.32
0.28
0.24
0.20
0.16
0.12
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 LOW RATE BIAXIAL CHS=0.2 IN/MIN STRAIN AT MAX STRESS (EM)

Figure 11



STAGE 1,WING 1&2 LOW RATE BIAXIAL CHS=0.2 IN/MIN MAXIMUM STRESS (SM)

Figure 12

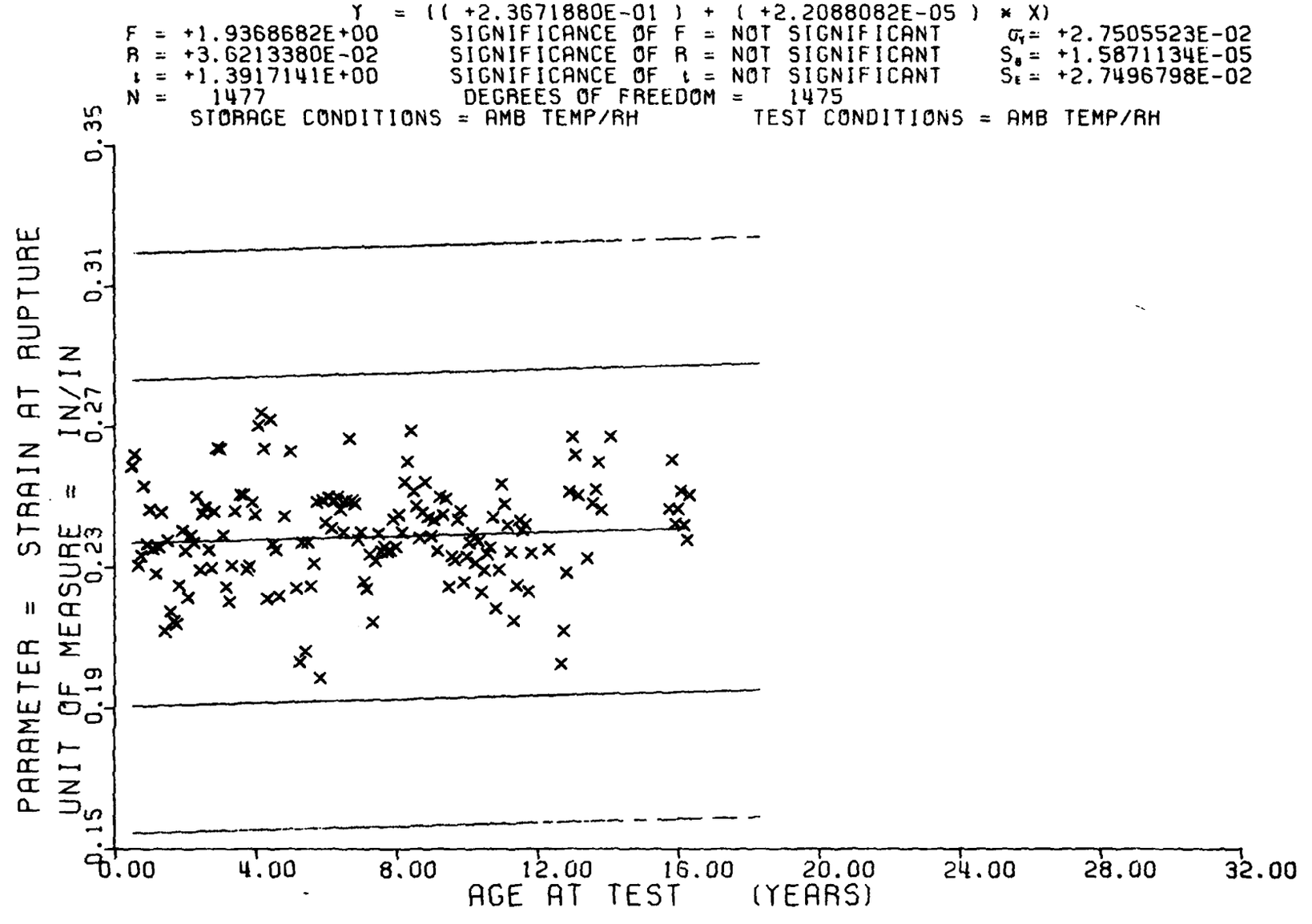
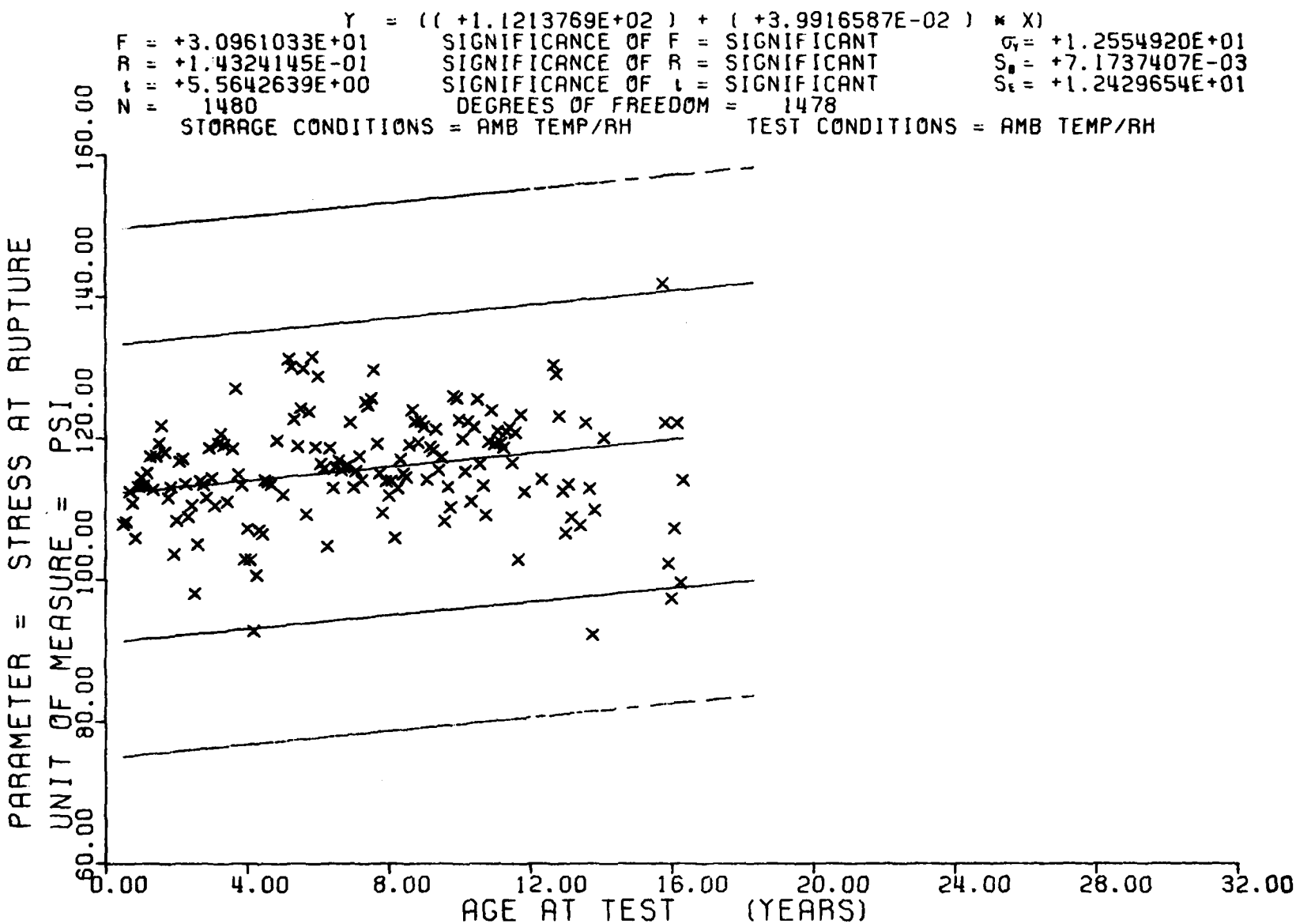

Y = ((+2.3671880E-01) + (+2.2088082E-05) * X)
F = +1.9368682E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +2.7505523E-02
R = +3.6213380E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +1.5871134E-05
t = +1.3917141E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_t = +2.7496798E-02
N = 1477 DEGREES OF FREEDOM = 1475
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.35
0.31
0.27
0.23
0.19
0.15
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 LOW RATE BIAXIAL CHS=0.2 IN/MIN STRAIN AT RUPTURE (ER)

Figure 13



STAGE 1,WING 1&2 LOW RATE BIAXIAL CHS=0.2 IN/MIN STRESS AT RUPTURE (SR)

Figure 14

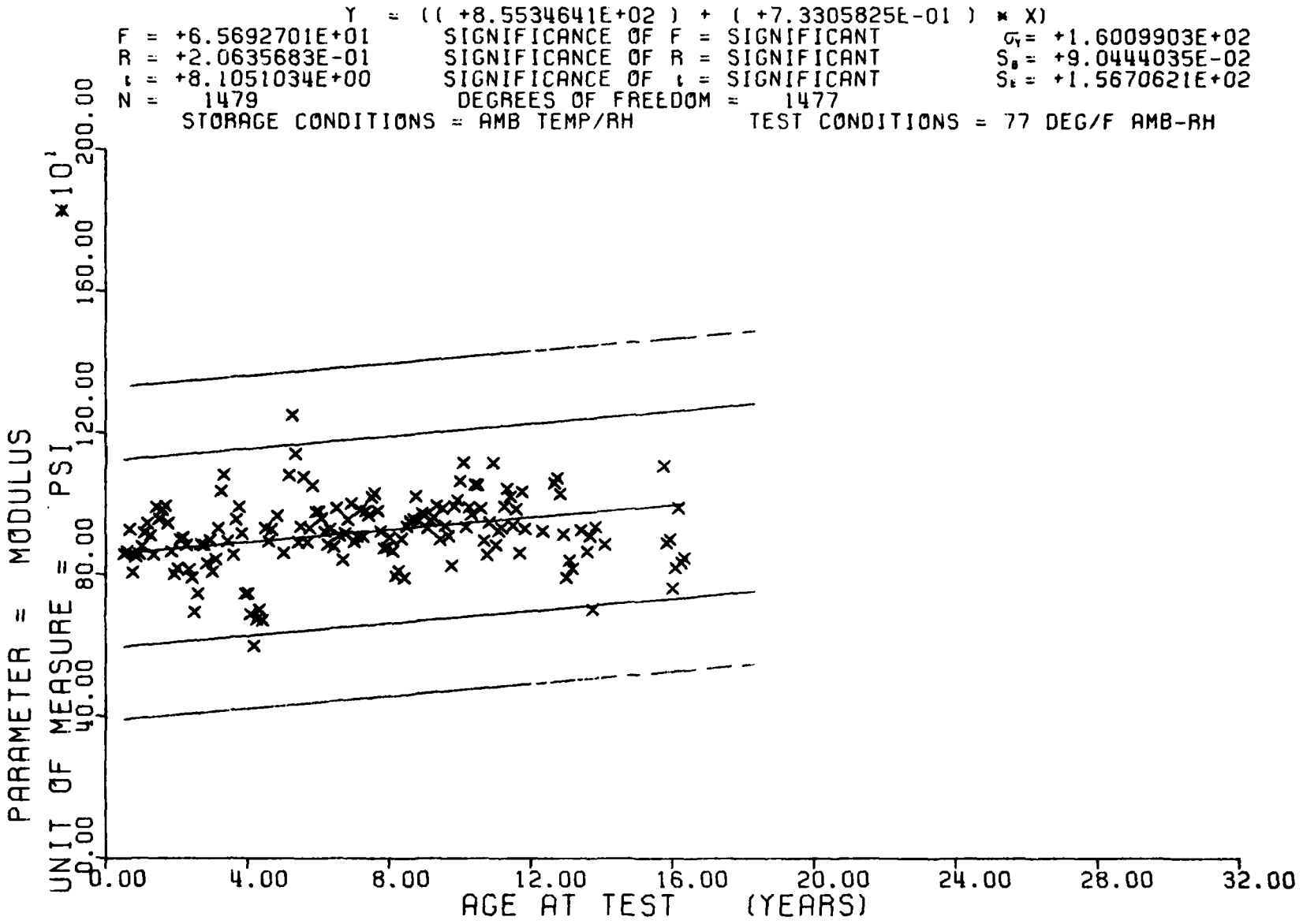

Y = ((+8.5534641E+02) + (+7.3305825E-01) * X)
F = +6.5692701E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = +2.0635683E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +8.1051034E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 1479 DEGREES OF FREEDOM = 1477
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 77 DEG/F AMB-RH
σY = +1.6009903E+02
Sb = +9.0444035E-02
St = +1.5670621E+02
PARAMETER = MODULUS
UNIT OF MEASURE = PSI *10¹
0.00
40.00
80.00
120.00
160.00
200.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 LOW RATE BIAXIAL CHS=0.2 IN/MIN MODULUS (E)

Figure 15

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
2	1	32	19	63	12	88	101	113	48	138	28
8	1	33	21	64	12	89	75	114	26	139	18
9	2	34	11	65	6	90	85	115	18	140	27
10	4	35	14	66	12	91	66	116	35	141	11
11	3	36	12	67	9	92	96	117	25	142	12
12	4	37	9	68	12	93	49	118	16	143	37
13	6	38	1	69	15	94	61	119	43	144	23
14	5	39	4	70	12	95	42	120	42	146	6
15	8	40	3	71	21	96	30	121	21	148	6
16	7	41	3	72	21	97	26	122	36	152	9
17	7	42	14	73	24	98	24	123	30	153	21
18	10	43	34	74	12	99	18	124	9	154	12
19	10	44	31	75	18	100	15	125	30	155	15
20	4	45	29	76	9	101	18	126	21	156	12
21	8	46	32	77	45	102	18	127	38	157	15
22	19	47	30	78	18	103	20	128	12	158	7
23	18	48	8	79	36	104	42	129	18	160	3
24	20	49	10	80	27	105	27	130	15	162	3
25	15	50	8	81	21	106	31	131	18	163	3
26	26	51	5	82	63	107	18	132	36	164	6
27	24	55	3	83	24	108	21	133	29	165	12
28	18	57	3	84	39	109	23	134	20	167	5
29	12	60	3	85	22	110	30	135	45	168	5
30	22	61	6	86	20	111	52	136	37	184	2
31	18	62	9	87	69	112	20	137	33	187	3
										191	9
										192	13
										193	14
										194	3
										195	1
										196	8

STAGE 1,WING 182 HIGH RATE CHS=1750 IN/MIN STRAIN AT MAX STRESS (EM)

This sample size summary is applicable to figures 16 thru 20

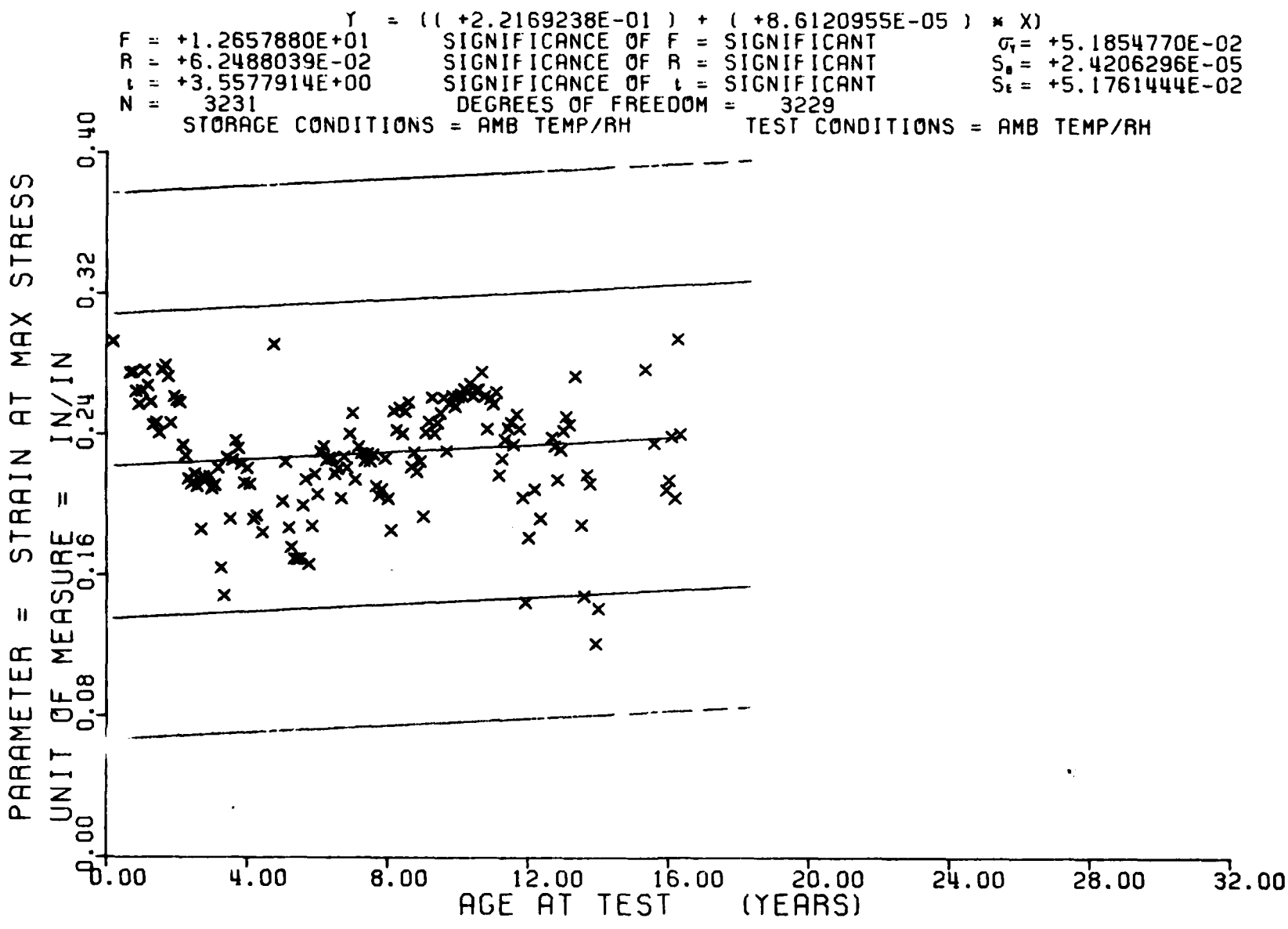

Y = ((+2.2169238E-01) + (+8.6120955E-05) * X)
F = +1.2657880E+01 SIGNIFICANCE OF F = SIGNIFICANT σY = +5.1854770E-02
R = +6.2488039E-02 SIGNIFICANCE OF R = SIGNIFICANT Sb = +2.4206296E-05
t = +3.5577914E+00 SIGNIFICANCE OF t = SIGNIFICANT St = +5.1761444E-02
N = 3231 DEGREES OF FREEDOM = 3229
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT MAX STRESS
UNIT OF MEASURE = IN/IN
0.00
0.08
0.16
0.24
0.32
0.40
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 HIGH RATE CHS=1750 IN/MIN STRAIN AT MAX STRESS (EM)

Figure 16

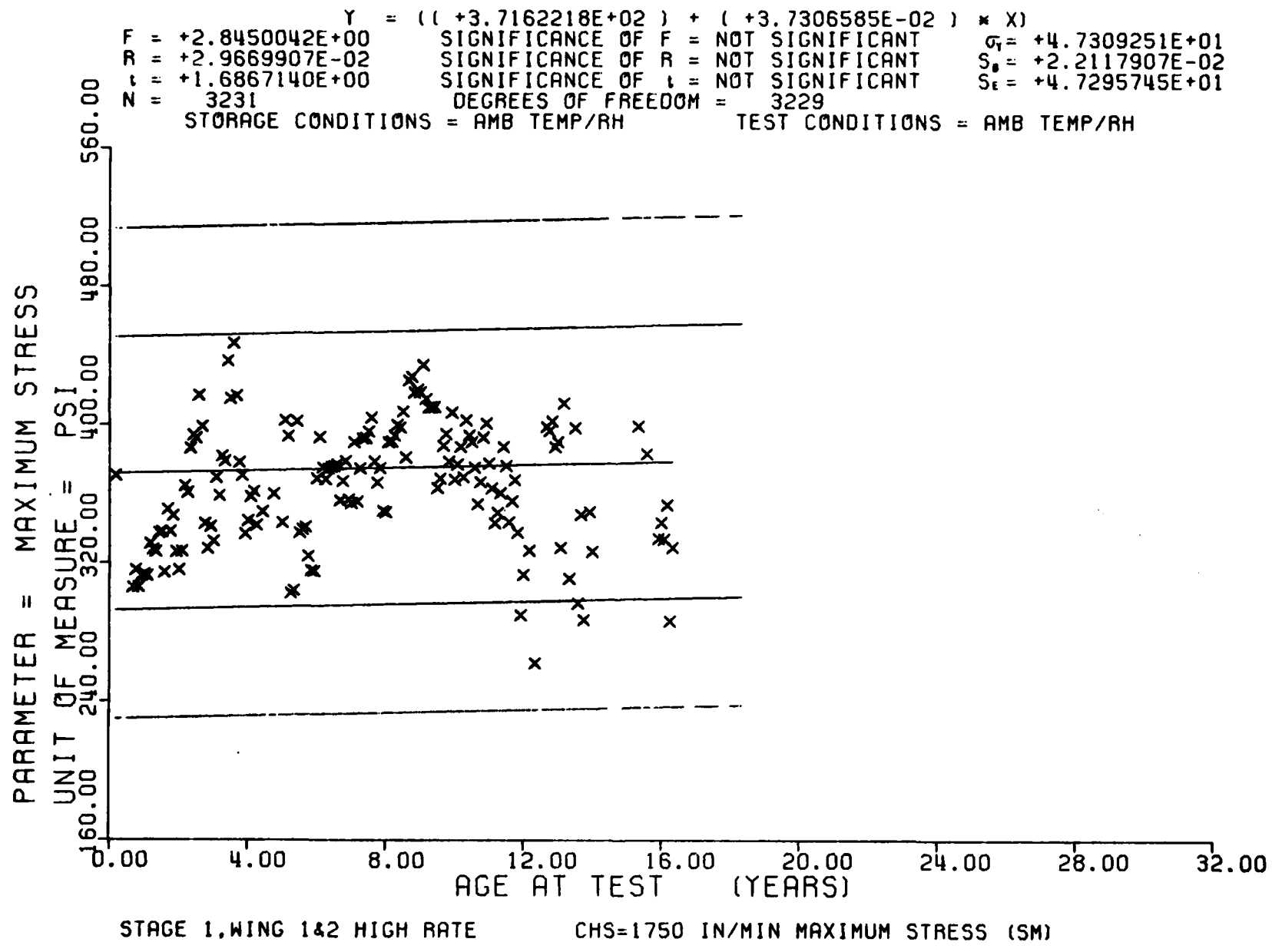

Y = ((+3.7162218E+02) + (+3.7306585E-02) * X)
F = +2.8450042E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σY = +4.7309251E+01
R = +2.9669907E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT Sθ = +2.2117907E-02
t = +1.6867140E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT Sε = +4.7295745E+01
N = 3231 DEGREES OF FREEDOM = 3229
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
560.00
480.00
400.00
320.00
240.00
160.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 HIGH RATE CHS=1750 IN/MIN MAXIMUM STRESS (SM)

Figure 17

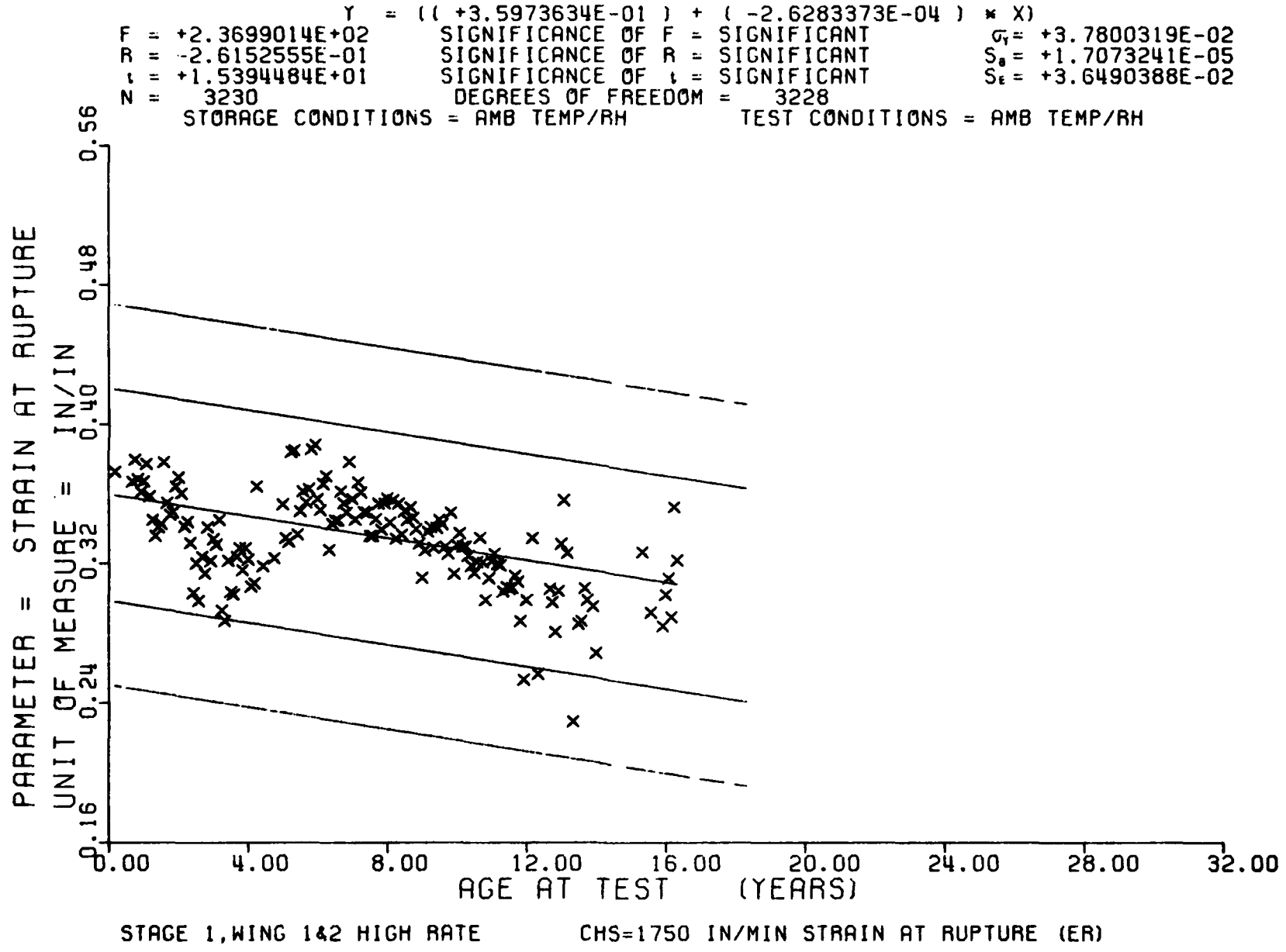

Y = ((+3.5973634E-01) + (-2.6283373E-04) * X)
F = +2.3699014E+02 SIGNIFICANCE OF F = SIGNIFICANT σY = +3.7800319E-02
R = -2.6152555E-01 SIGNIFICANCE OF R = SIGNIFICANT Sθ = +1.7073241E-05
t = +1.5394484E+01 SIGNIFICANCE OF t = SIGNIFICANT Sε = +3.6490388E-02
N = 3230 DEGREES OF FREEDOM = 3228
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.56
0.48
0.40
0.32
0.24
0.16
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 HIGH RATE CHS=1750 IN/MIN STRAIN AT RUPTURE (ER)

Figure 18

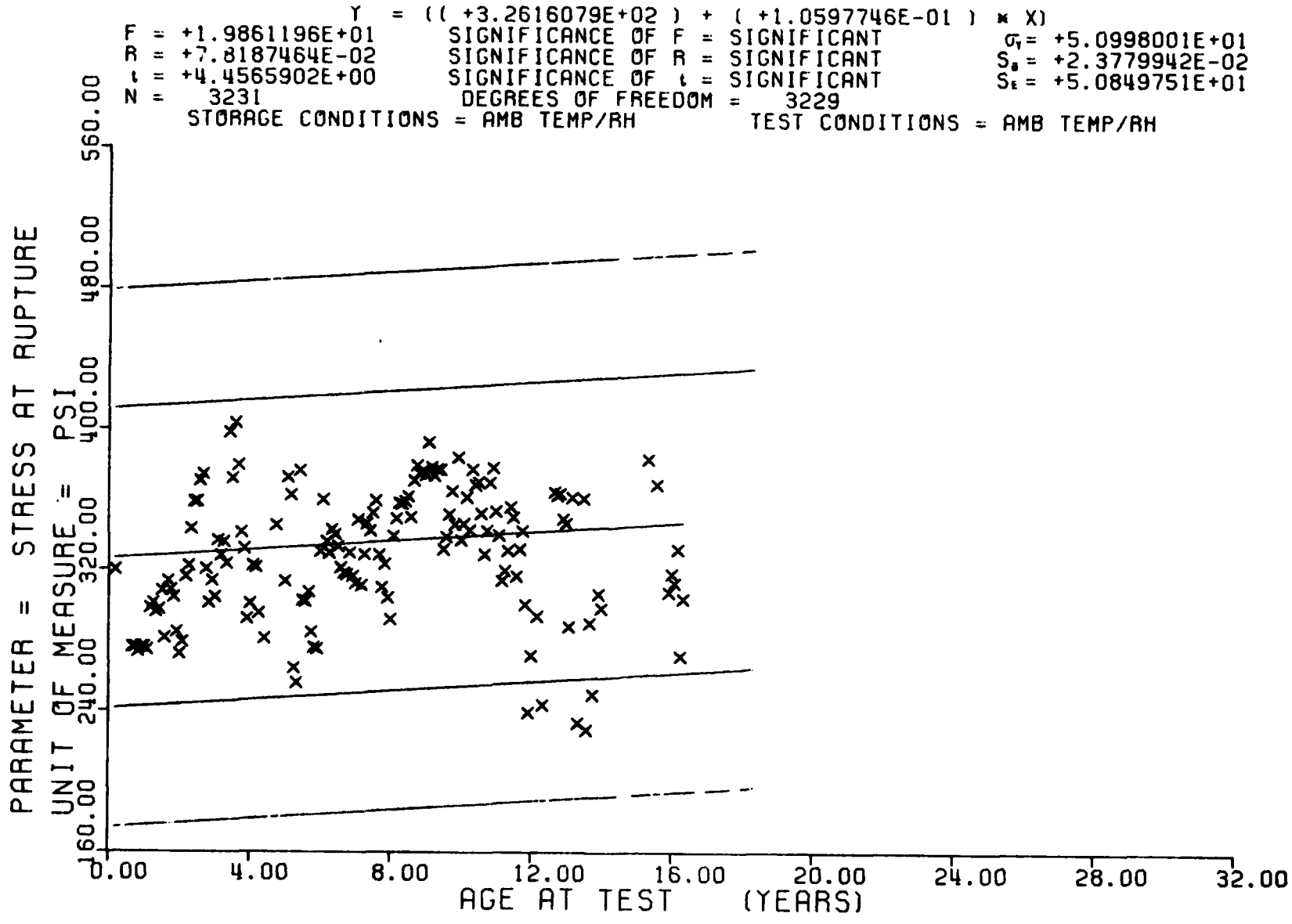

Y = ((+3.2616079E+02) + (+1.0597746E-01) * X)
F = +1.9861196E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = +7.8187464E-02 SIGNIFICANCE OF R = SIGNIFICANT
t = +4.4565902E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 3231 DEGREES OF FREEDOM = 3229
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
σY = +5.0998001E+01
Sa = +2.3779942E-02
Sε = +5.0849751E+01
PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI
560.00
480.00
400.00
320.00
240.00
160.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 HIGH RATE CHS=1750 IN/MIN STRESS AT RUPTURE (SR)

Figure 19

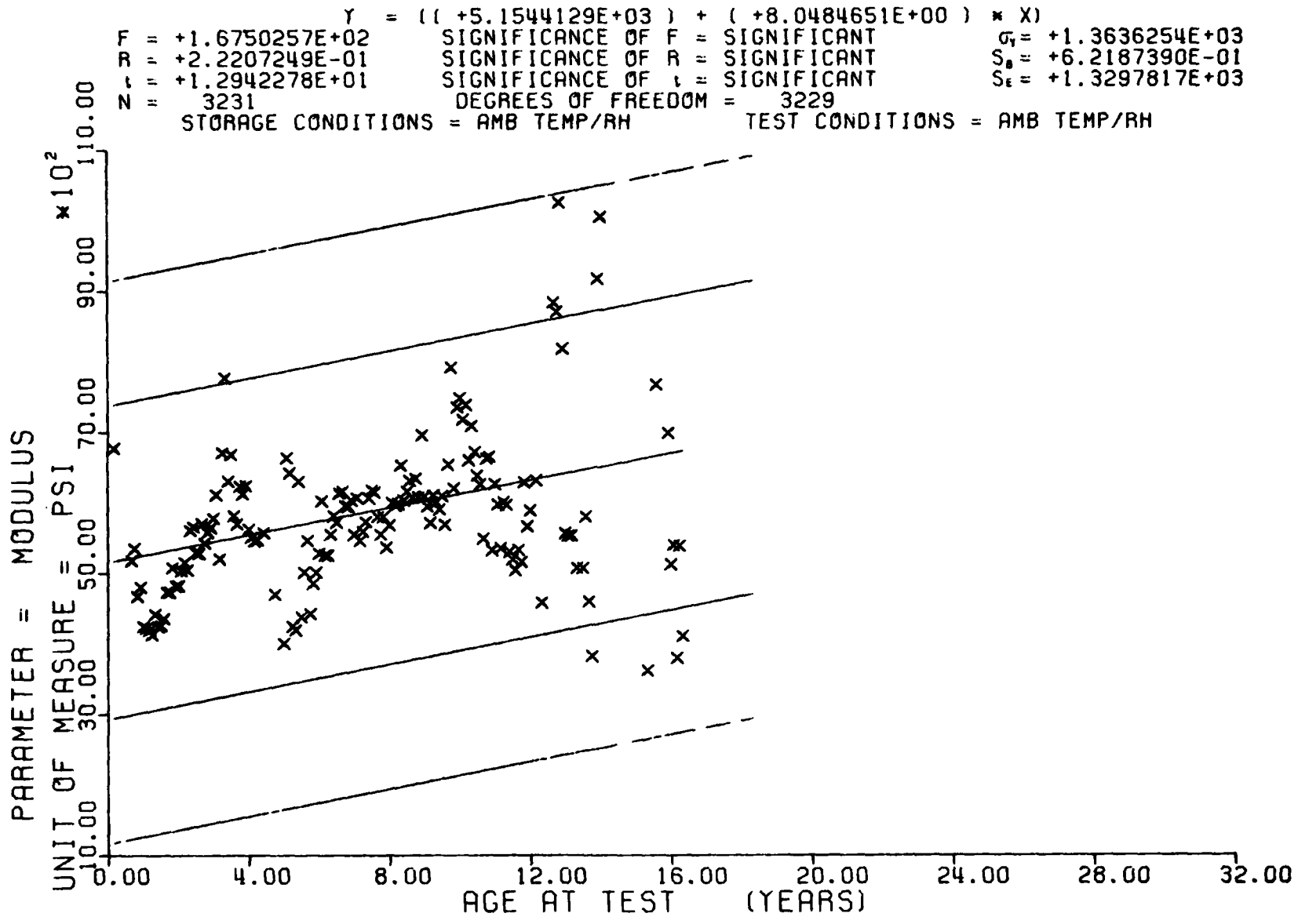

Y = ((+5.1544129E+03) + (+8.0484651E+00) * X)
F = +1.6750257E+02 SIGNIFICANCE OF F = SIGNIFICANT
R = +2.2207249E-01 SIGNIFICANCE OF R = SIGNIFICANT
N = 3231 DEGREES OF FREEDOM = 3229
STORAGE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MODULUS
UNIT OF MEASURE = PSI *10²
10.00
30.00
50.00
70.00
90.00
110.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 HIGH RATE
CHS=1750 IN/MIN MODULUS (E)

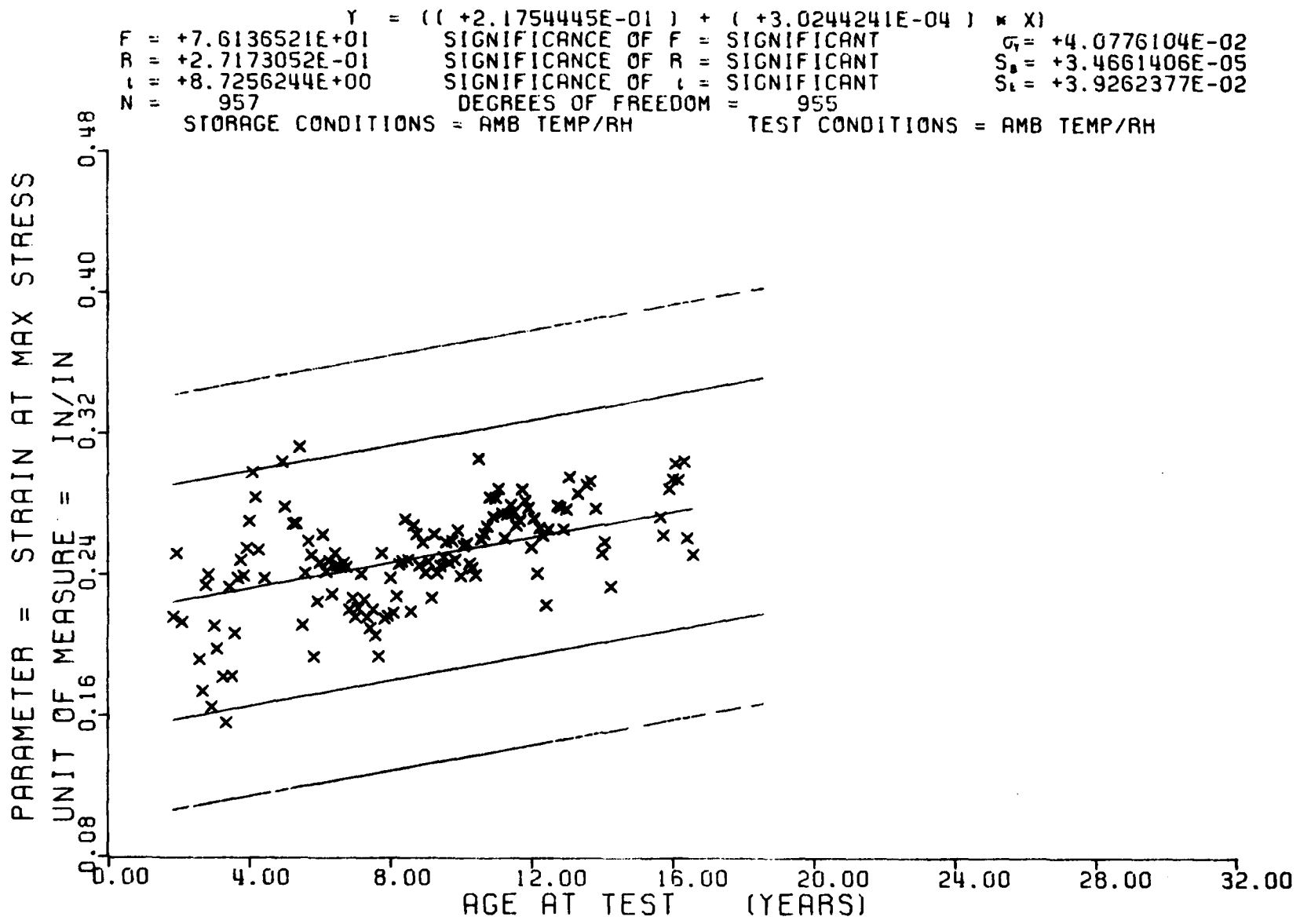
Figure 20

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
22	1	60	3	87	14	112	14	137	6	171	6
23	1	63	4	88	21	113	7	138	3	188	2
25	2	64	4	89	25	114	5	139	5	189	2
31	1	65	3	90	28	115	6	140	3	191	8
32	1	66	3	91	13	116	9	141	3	192	2
33	2	67	2	92	5	117	8	142	2	193	8
34	2	68	2	93	6	118	9	143	5	194	2
35	1	69	2	94	8	119	11	144	10	196	3
36	3	70	3	95	9	120	11	145	1	197	1
37	2	71	8	96	8	121	9	146	3	199	1
39	2	72	9	97	8	122	15	147	2		
40	1	73	4	98	18	123	6	148	1		
41	5	74	7	99	10	124	9	149	1		
42	2	75	18	100	10	125	16	150	2		
43	5	76	5	101	8	126	3	153	8		
44	15	77	9	102	10	127	7	154	3		
45	29	78	10	103	5	128	10	155	12		
46	25	79	5	104	7	129	8	156	9		
47	35	80	11	105	7	130	7	157	3		
48	7	81	4	106	12	131	3	160	3		
49	12	82	13	107	13	132	8	163	2		
50	4	83	7	108	14	133	12	164	1		
51	3	84	4	109	8	134	12	166	2		
53	2	85	15	110	12	135	2	168	4		
59	1	86	5	111	7	136	8	169	3		

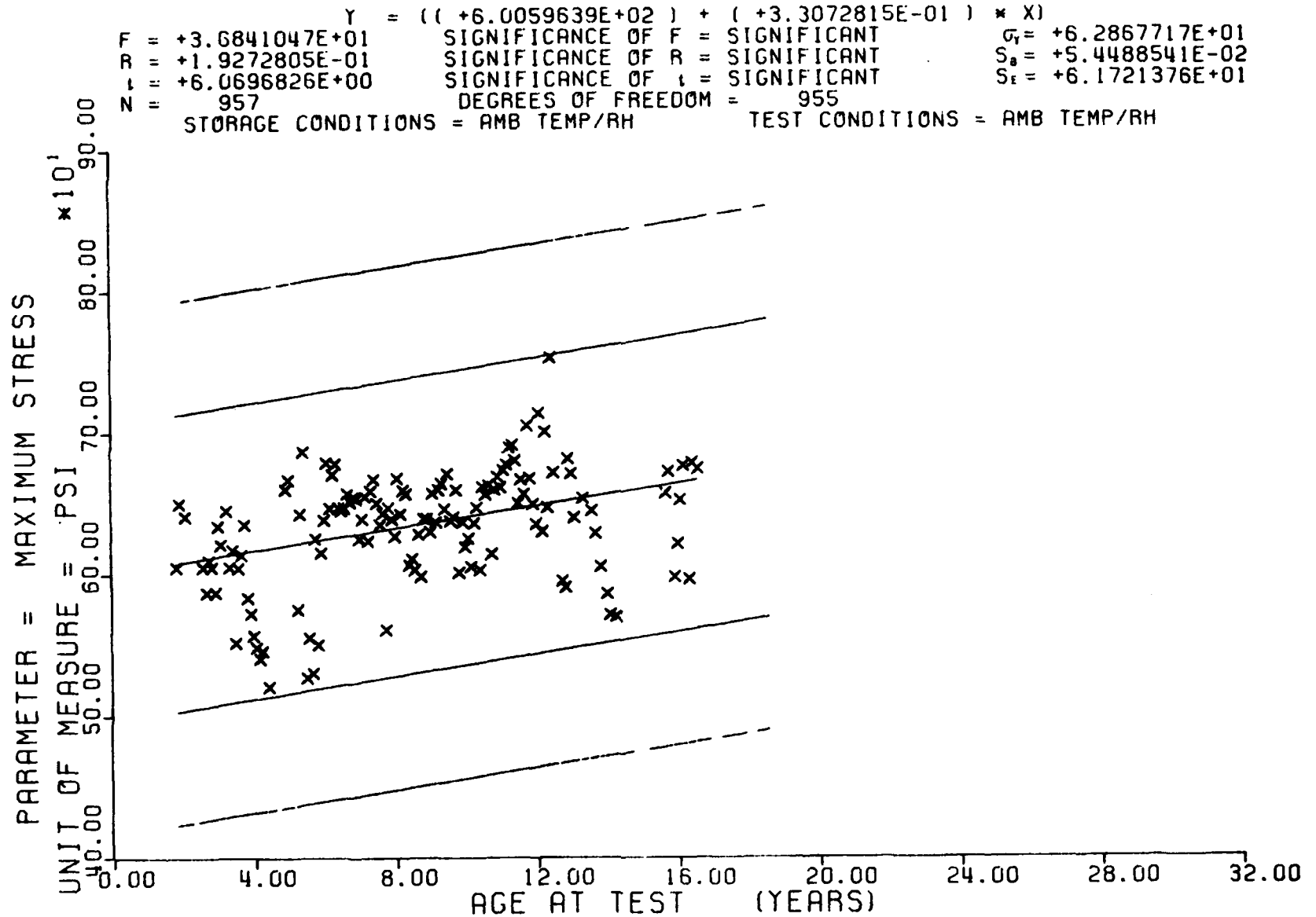
STAGE 1,WING 162 H.R. TRIAXIAL CHS=1750,PSI=600, STRAIN AT MAX STRESS (EM)

This sample size summary is applicable to figures 21 thru 25



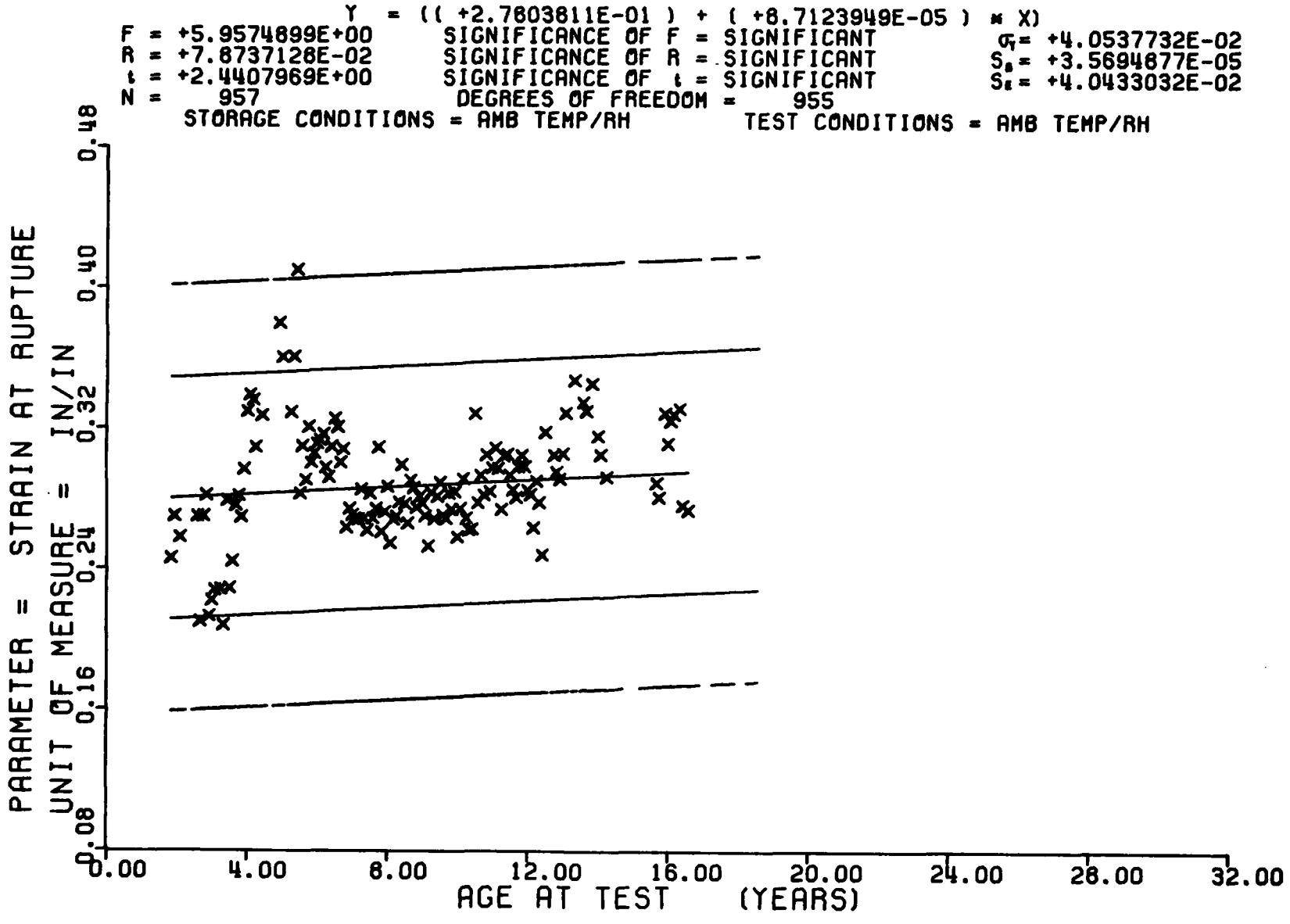
STAGE 1,WING 1&2 H.R. TRIAXIAL CHS=1750,PSI=600, STRAIN AT MAX STRESS (EM)

Figure 21



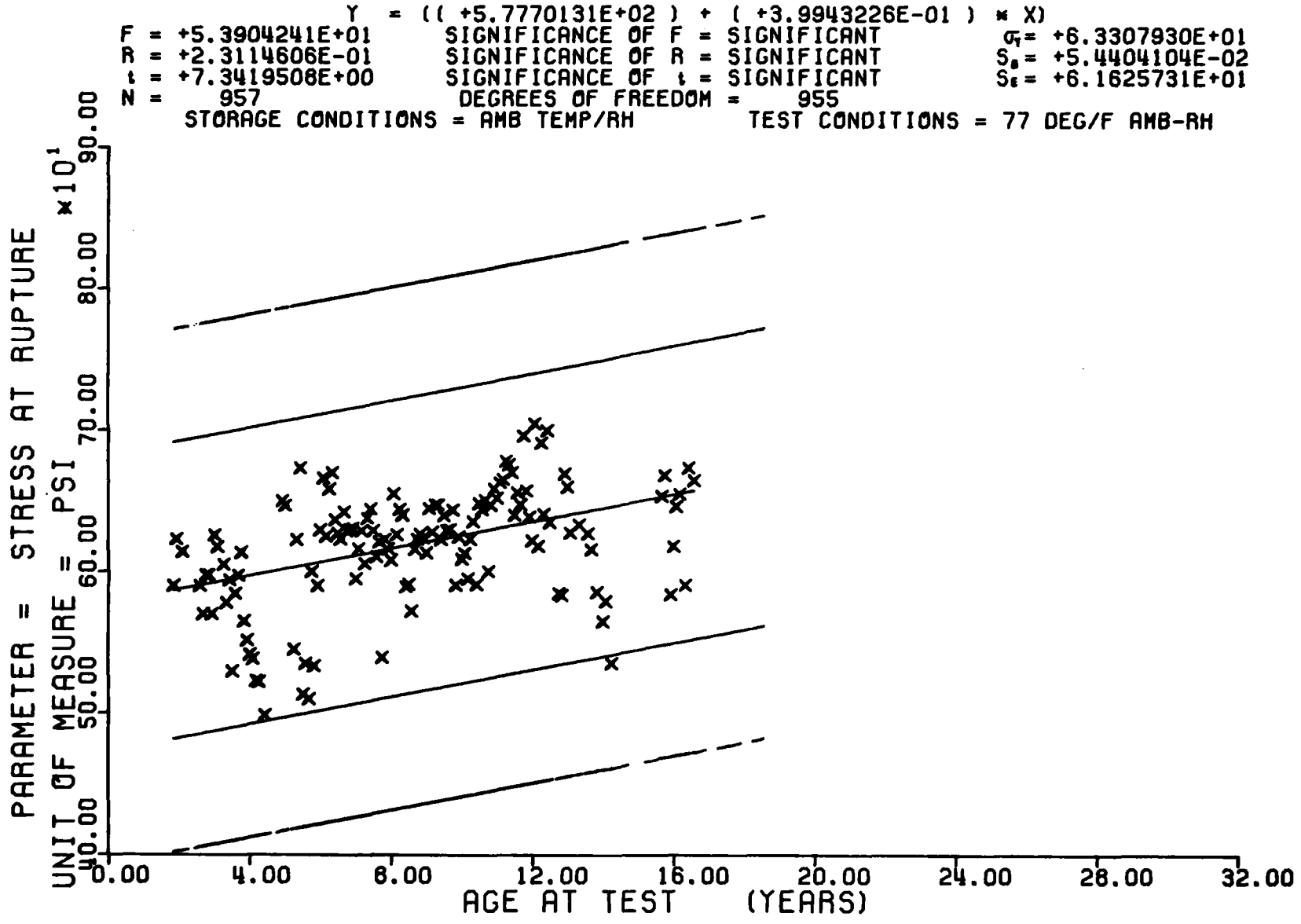
STAGE 1,WING 1&2 H.R. TRIAXIAL CHS=1750,PSI=600, MAXIMUM STRESS (SM)

Figure 22



STAGE 1,WING 1&2 H.R. TRIAXIAL CHS=1750,PSI=600, STRAIN AT RUPTURE (ER)

Figure 23



STAGE 1,WING 1&2 H.R. TRIAXIAL CHS=1750,PSI=600, STRESS AT RUPTURE (SR)

Figure 24

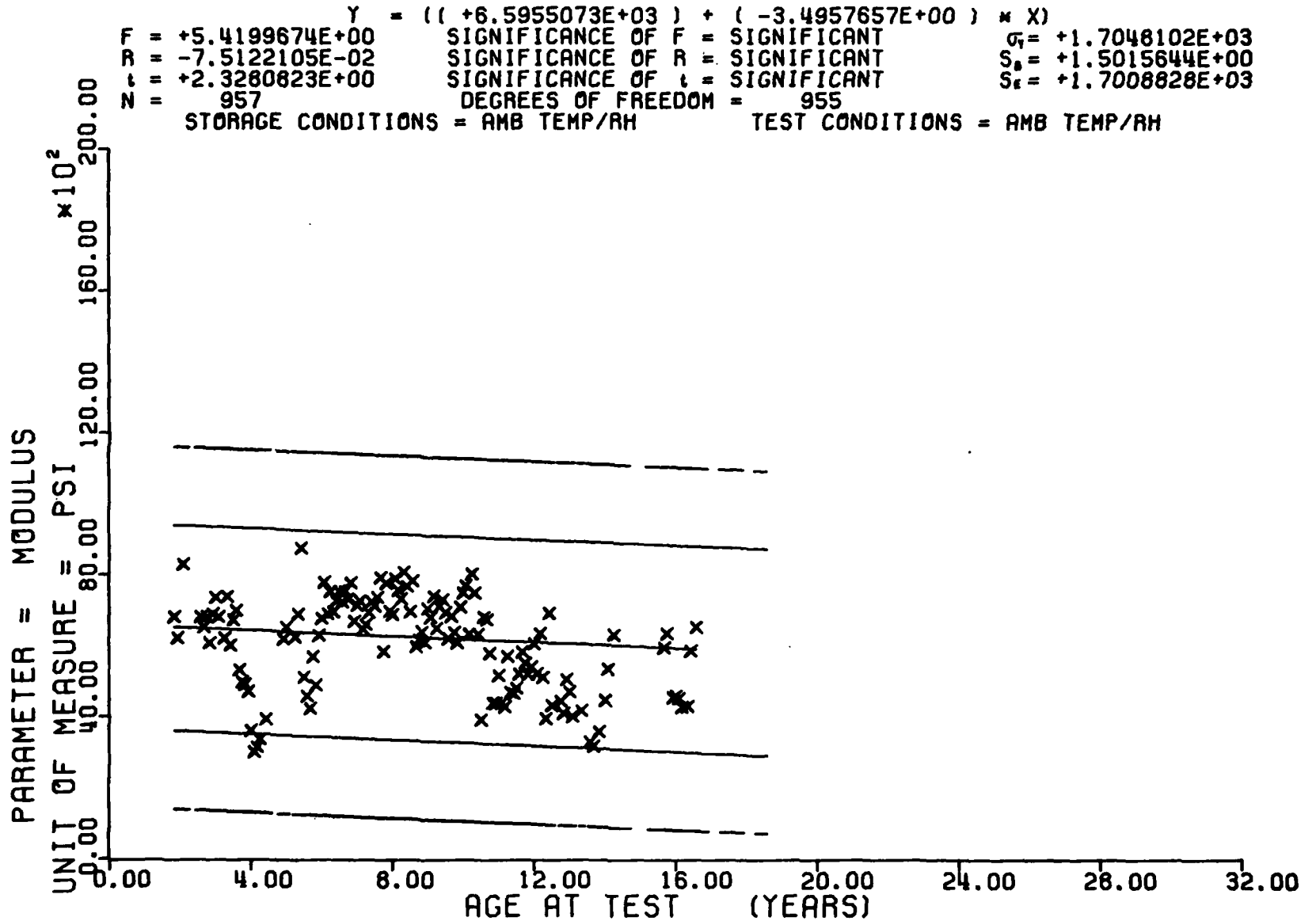

Y = ((+6.5955073E+03) + (-3.4957657E+00) * X)
F = +5.4199674E+00 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +1.7048102E+03
R = -7.5122105E-02 SIGNIFICANCE OF R = SIGNIFICANT Sa = +1.5015644E+00
t = +2.3260823E+00 SIGNIFICANCE OF t = SIGNIFICANT Se = +1.7008828E+03
N = 957 DEGREES OF FREEDOM = 955
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MODULUS
UNIT OF MEASURE = PSI *10²
200.00
160.00
120.00
80.00
40.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2 M.R. TRIAXIAL CMS=1750,PSI=600, MODULUS (E)

Figure 25

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
7	4	32	35	64	9	89	66	114	33	139	27
8	5	33	38	65	12	90	72	115	36	140	18
9	5	34	30	66	12	91	113	116	20	141	33
10	4	35	29	67	24	92	63	117	35	142	15
11	5	36	29	68	6	93	93	118	21	144	3
12	7	37	23	69	17	94	60	119	36	145	3
13	6	38	20	70	27	95	39	120	42	147	6
14	10	39	12	71	24	96	30	121	15	151	3
15	12	40	28	72	24	97	23	122	9	152	3
16	9	41	38	73	21	98	30	123	12	153	24
17	6	42	84	74	21	99	15	124	27	154	15
18	8	43	63	75	21	100	48	125	21	155	15
19	7	44	50	76	30	101	36	126	44	156	12
20	11	45	39	77	15	102	27	127	51	157	6
21	12	46	48	78	27	103	43	128	21	158	3
22	9	47	36	79	27	104	34	129	33	160	9
23	8	48	15	80	30	105	27	130	18	162	6
24	8	49	17	81	18	106	33	131	27	163	3
25	18	50	5	82	36	107	24	132	28	164	3
26	13	51	4	83	27	108	33	133	18	165	6
27	17	52	3	84	27	109	27	134	33	166	6
28	17	53	5	85	33	110	21	135	36	168	3
29	29	58	3	86	33	111	18	136	39	188	3
30	29	62	3	87	69	112	36	137	33	189	6
31	51	63	3	88	69	113	21	138	15	191	15
										192	15
										193	12
										194	7
										196	6
										197	3

STAGE I, WING 1&2, STRESS RELAXATION 3.0% 10 SEC TEST TEMP. 77 DEG

This sample size summary is applicable to figures 26 thru 29

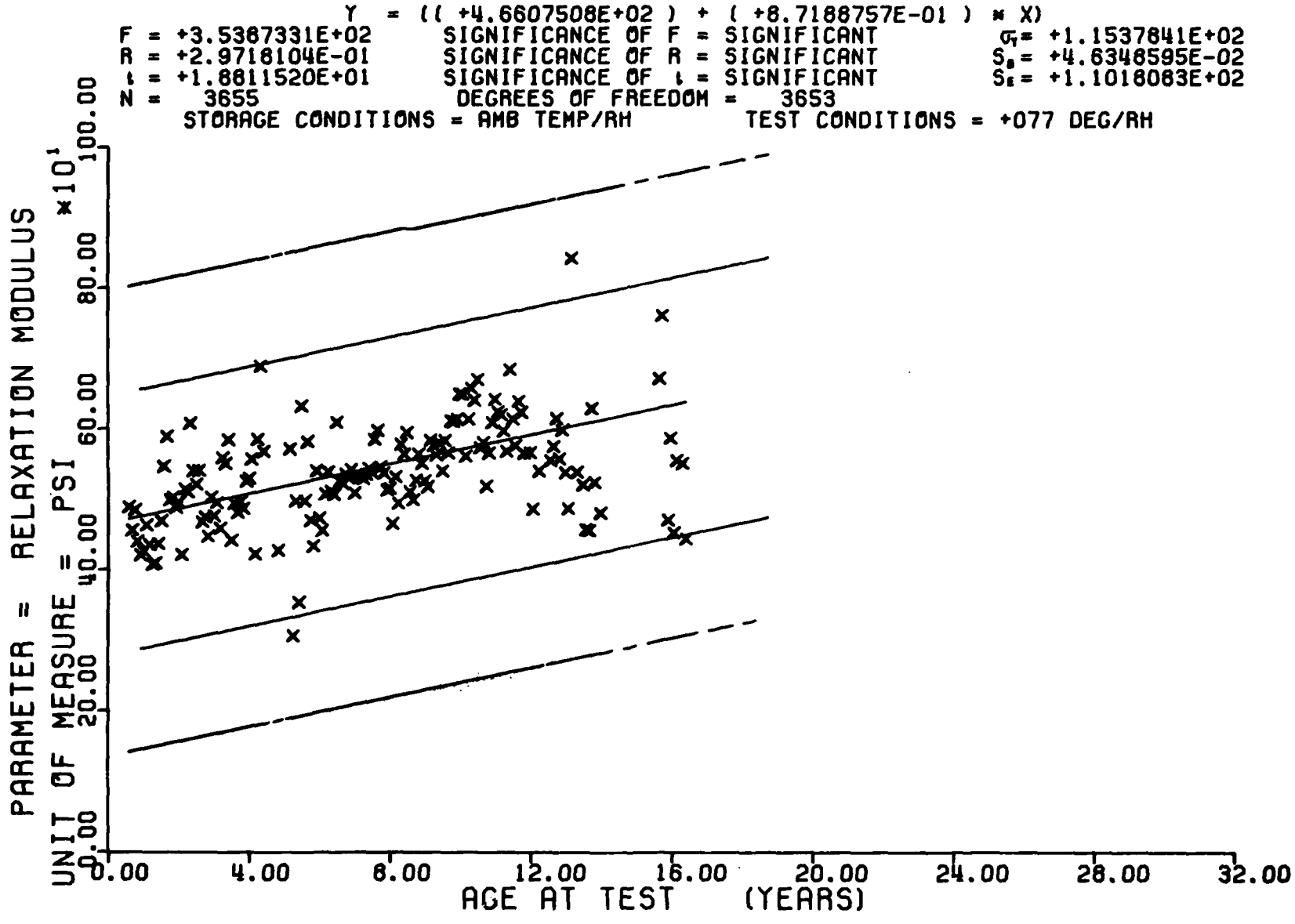

Y = ((+4.6607508E+02) + (+8.7188757E-01) * X)
F = +3.5367331E+02 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +1.1537841E+02
R = +2.9718104E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +4.6348595E-02
t = +1.8811520E+01 SIGNIFICANCE OF t = SIGNIFICANT Se = +1.1018083E+02
N = 3655 DEGREES OF FREEDOM = 3653
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH
PARAMETER = RELAXATION MODULUS
UNIT OF MEASURE = PSI *10¹
100.00
80.00
60.00
40.00
20.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE I,WING 142,STRESS RELAXATION 3.0% 10 SEC TEST TEMP. 77 DEG

Figure 26

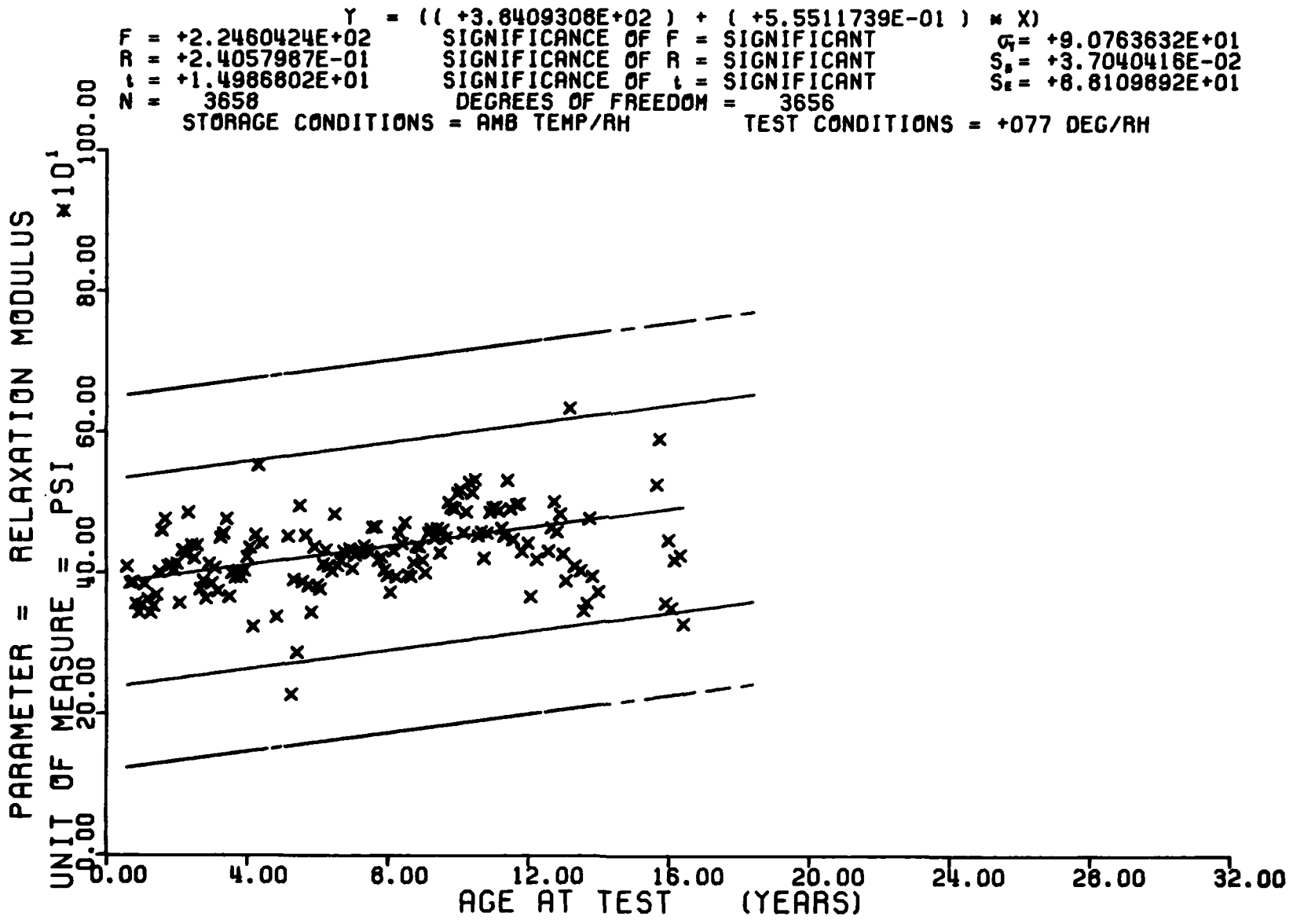

Y = ((+3.8409308E+02) + (+5.5511739E-01) * X)
F = +2.2460424E+02 SIGNIFICANCE OF F = SIGNIFICANT σ = +9.0763632E+01
R = +2.4057987E-01 SIGNIFICANCE OF R = SIGNIFICANT S = +3.7040416E-02
t = +1.4986802E+01 SIGNIFICANCE OF t = SIGNIFICANT S = +8.8109892E+01
N = 3658 DEGREES OF FREEDOM = 3656
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH
PARAMETER = RELAXATION MODULUS
UNIT OF MEASURE = PSI
×10¹
100.00
80.00
60.00
40.00
20.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE I,WING 142,STRESS RELAXATION 3.0% 50 SEC TEST TEMP. 77 DEG

Figure 27

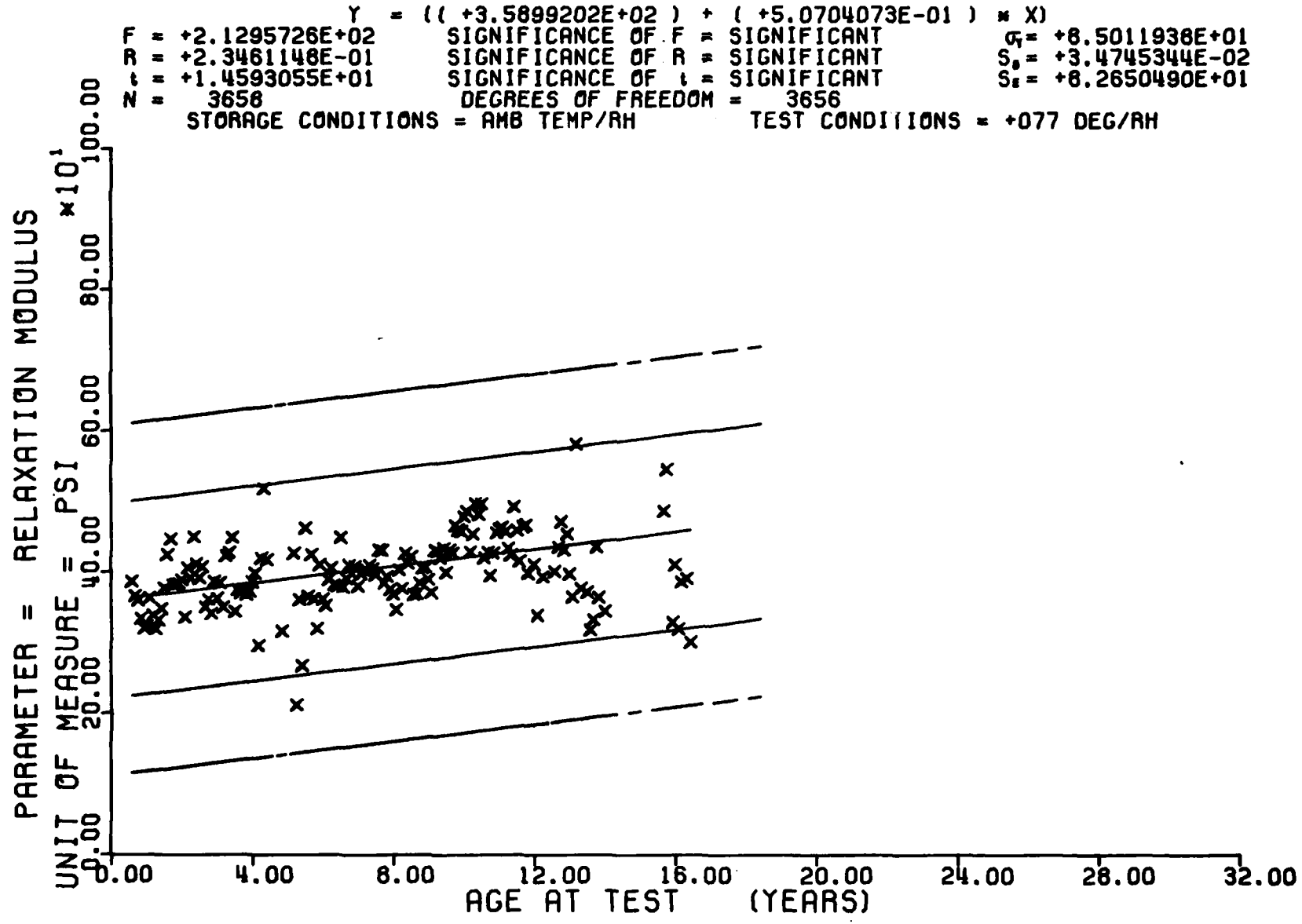
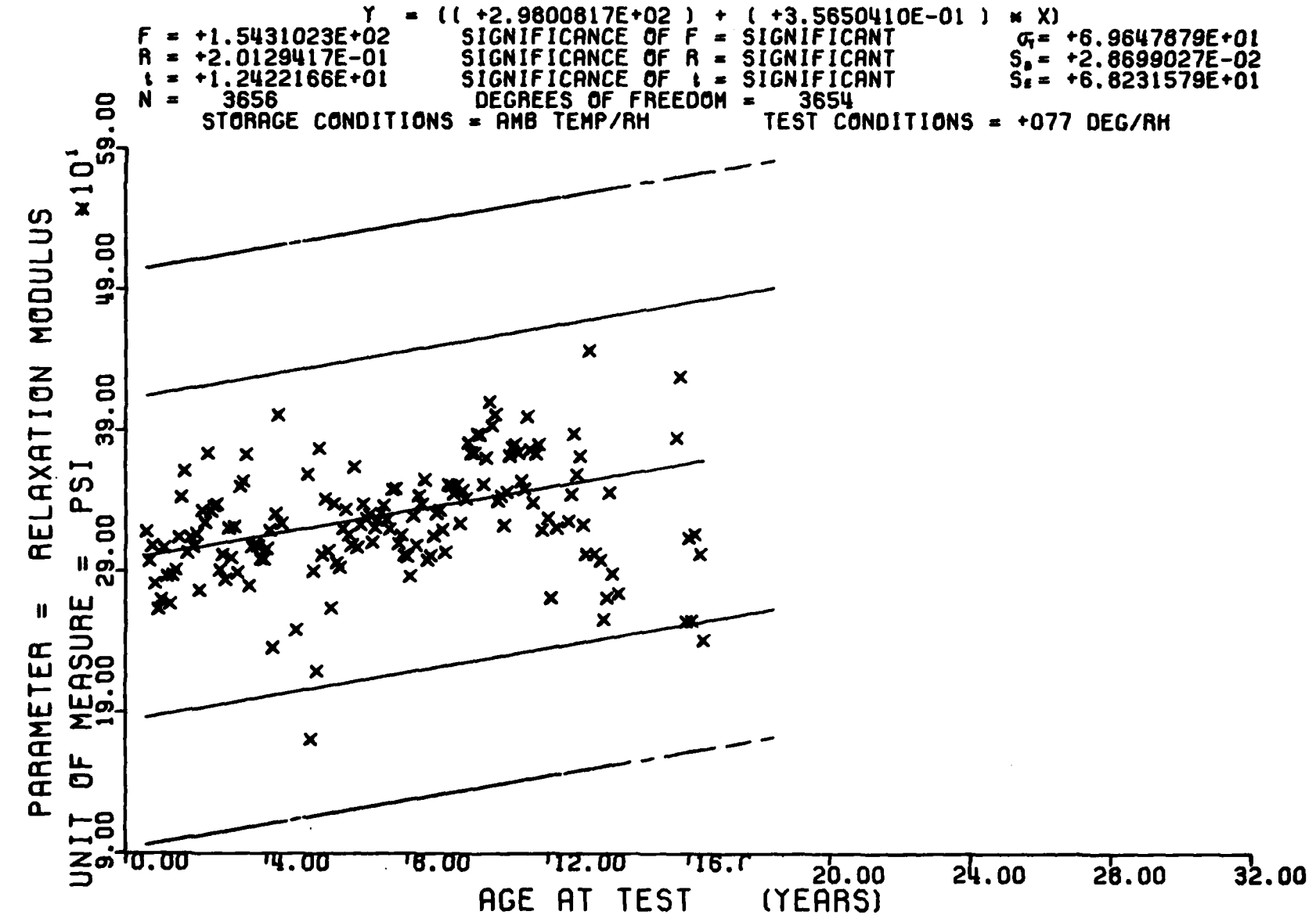

Y = ((+3.5899202E+02) + (+5.0704073E-01) * X)
F = +2.1295726E+02 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +8.5011936E+01
R = +2.3461148E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +3.4745344E-02
t = +1.4593055E+01 SIGNIFICANCE OF t = SIGNIFICANT S_E = +8.2650490E+01
N = 3658 DEGREES OF FREEDOM = 3656
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH
PARAMETER = RELAXATION MODULUS
UNIT OF MEASURE = PSI *10^1
0.00
20.00
40.00
60.00
80.00
100.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE I,WING 142,STRESS RELAXATION 3.0% 100 SEC TEST TEMP. 77 DEG

Figure 28



STAGE I,WING 1&2,STRESS RELAXATION 3.0% 1000 SEC TEST TEMP. 77 DEG

Figure 29

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
7	4	32	40	63	3	88	66	113	18	138	15
8	3	33	38	64	9	89	69	114	33	139	30
9	5	34	30	65	12	90	81	115	30	140	18
10	4	35	30	66	12	91	99	116	27	141	32
11	5	36	27	67	24	92	69	117	39	142	15
12	7	37	26	68	6	93	90	118	21	144	3
13	6	38	20	69	18	94	60	119	36	145	3
14	10	39	23	70	27	95	36	120	42	147	6
15	12	40	27	71	27	96	30	121	15	152	3
16	9	41	38	72	26	97	27	122	9	153	24
17	6	42	60	73	21	98	30	123	12	154	15
18	6	43	61	74	21	99	18	124	24	155	15
19	7	44	44	75	27	100	39	125	27	156	12
20	11	45	40	76	36	101	39	126	33	157	6
21	12	46	48	77	15	102	30	127	44	158	3
22	9	47	36	78	27	103	36	128	40	160	9
23	8	48	15	79	27	104	27	129	21	162	6
24	8	49	17	80	30	105	38	130	27	163	3
25	18	50	5	81	20	106	36	131	27	164	3
26	13	51	13	82	33	107	24	132	33	165	6
27	17	52	4	83	27	108	33	133	21	166	6
28	17	53	5	84	27	109	27	134	33	168	3
29	29	58	3	85	33	110	24	135	33	186	3
30	29	60	3	86	32	111	18	136	39	189	6
31	51	62	3	87	69	112	36	137	27	191	20
										192	9
										193	12
										194	6
										196	6
										197	3

STAGE 1,WING 1&2,STRESS RELAXATION 5.0% 10 SEC TEST TEMP. 77 DEG

This sample size summary is applicable to figures 30 thru 33

Y = ((+5.4144764E+02) + (+8.0211364E-01) * X)

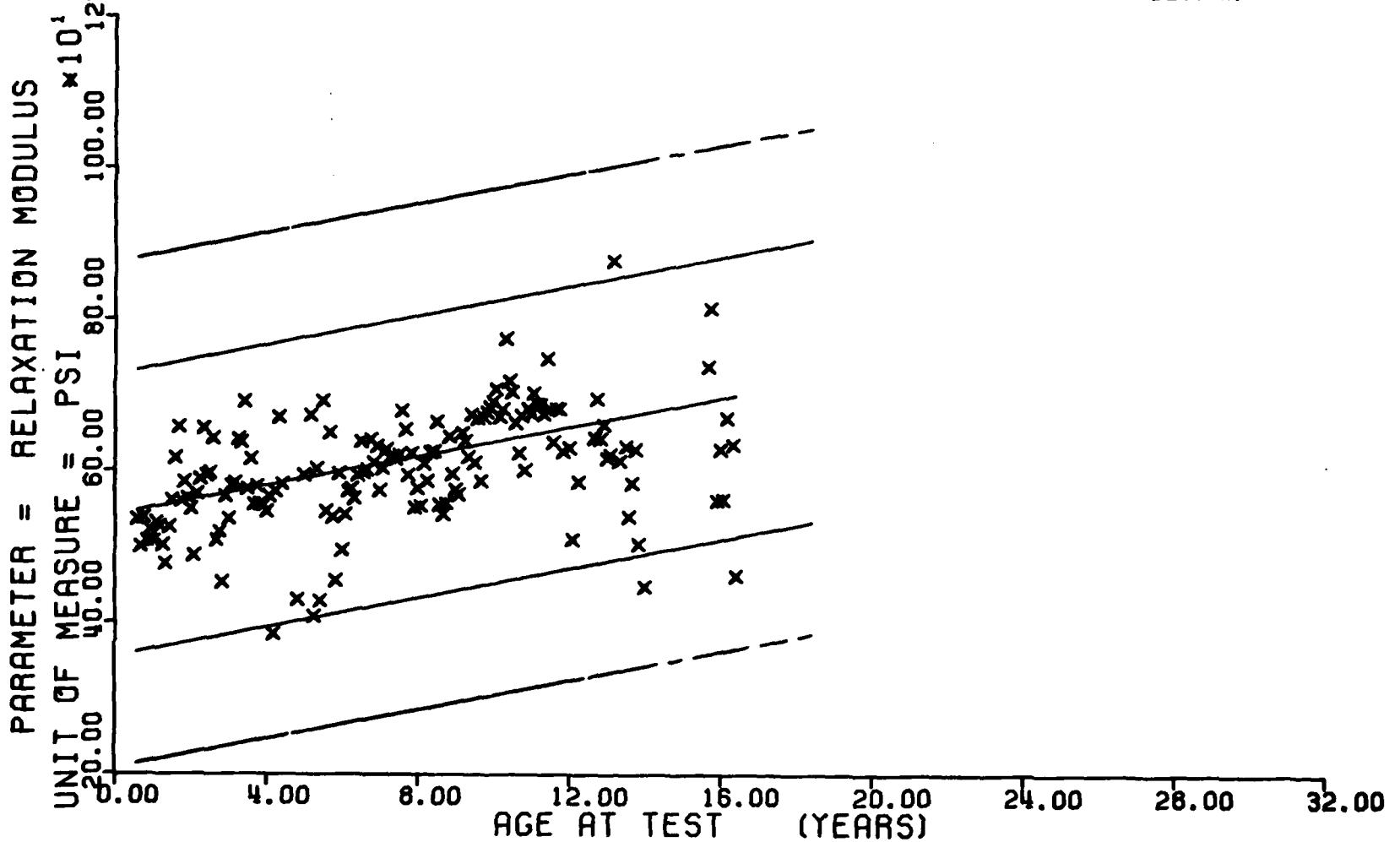
F = +2.9375256E+02 SIGNIFICANCE OF F = SIGNIFICANT σ_1 = +1.1562607E+02

R = +2.7164909E-01 SIGNIFICANCE OF R = SIGNIFICANT S_β = +4.6799913E-02

t = +1.7139212E+01 SIGNIFICANCE OF t = SIGNIFICANT S_ε = +1.1129320E+02

N = 3689 DEGREES OF FREEDOM = 3687

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH



STAGE I,WING 1&2,STRESS RELAXATION 5.0% 10 SEC TEST TEMP. 77 DEG

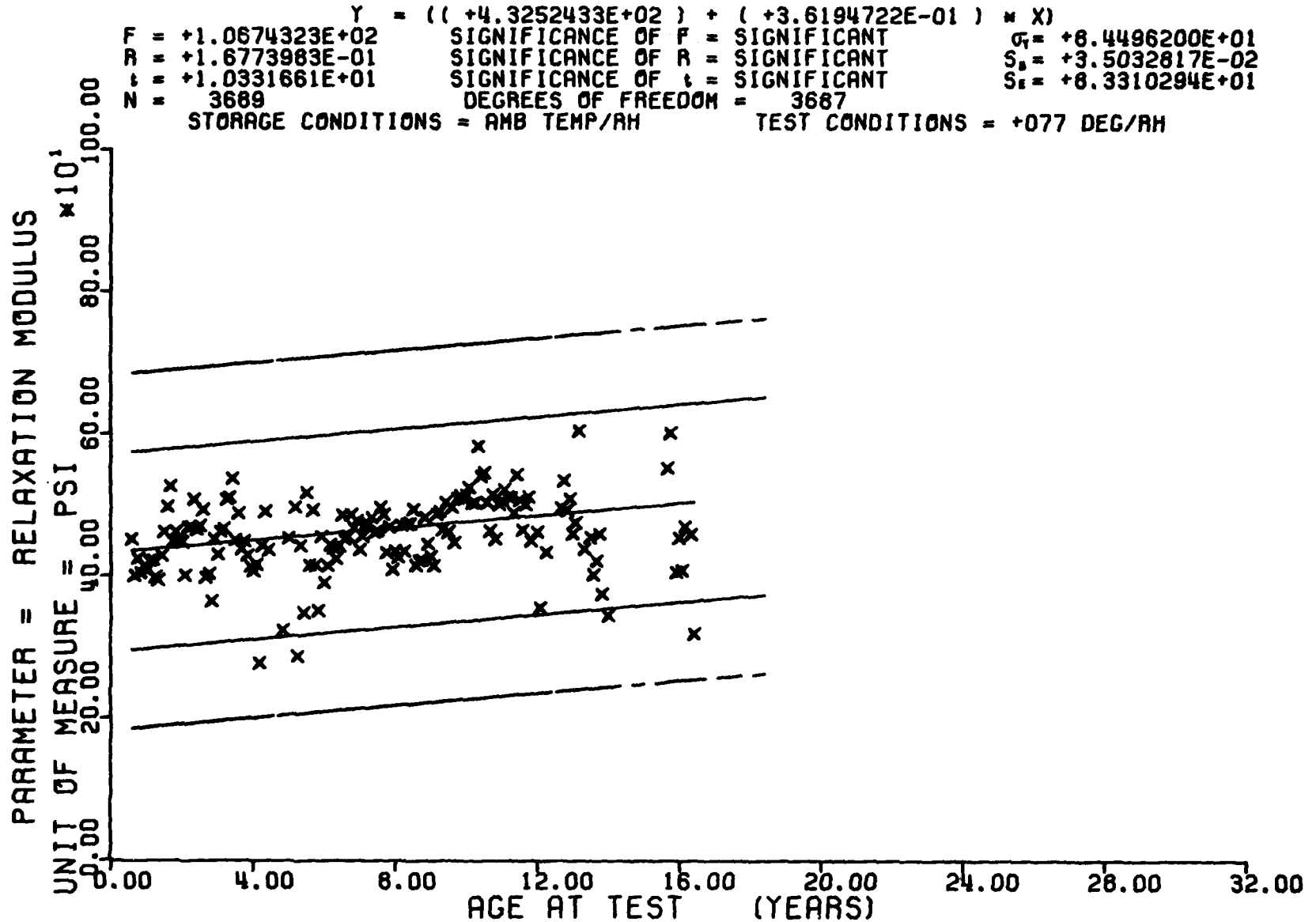
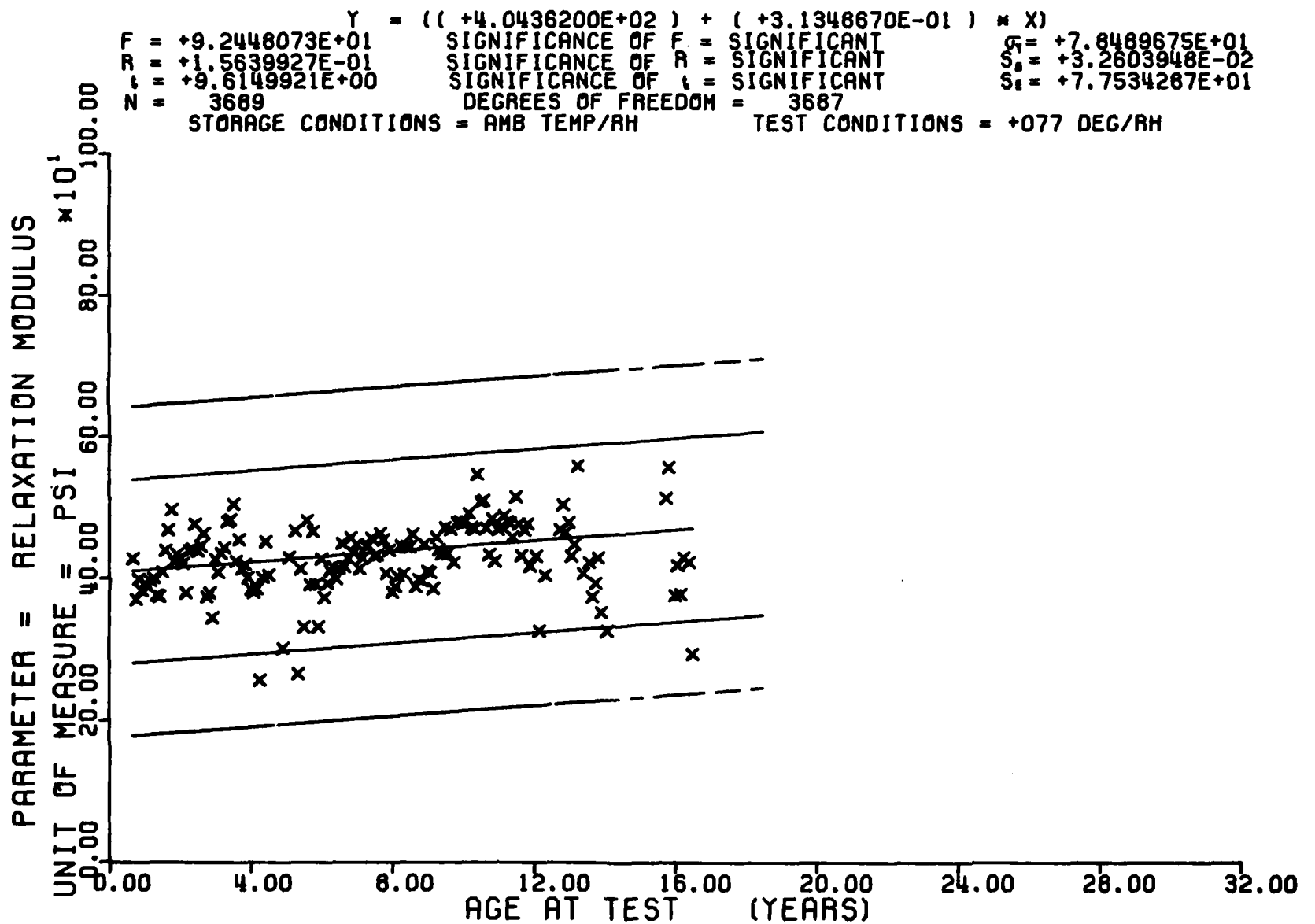

Y = ((+4.3252433E+02) + (+3.6194722E-01) * X)
F = +1.0674323E+02 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +8.4496200E+01
R = +1.6773983E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +3.5032817E-02
t = +1.0331661E+01 SIGNIFICANCE OF t = SIGNIFICANT Se = +8.3310294E+01
N = 3689 DEGREES OF FREEDOM = 3687
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH
PARAMETER = RELAXATION MODULUS
UNIT OF MEASURE = PSI *10¹
100.00
80.00
60.00
40.00
20.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE I,WING 1&2,STRESS RELAXATION 5.0% 50 SEC TEST TEMP. 77 DEG

Figure 31



STAGE I,WING 1&2,STRESS RELAXATION 5.0% 100 SEC TEST TEMP. 77 DEG

Figure 32

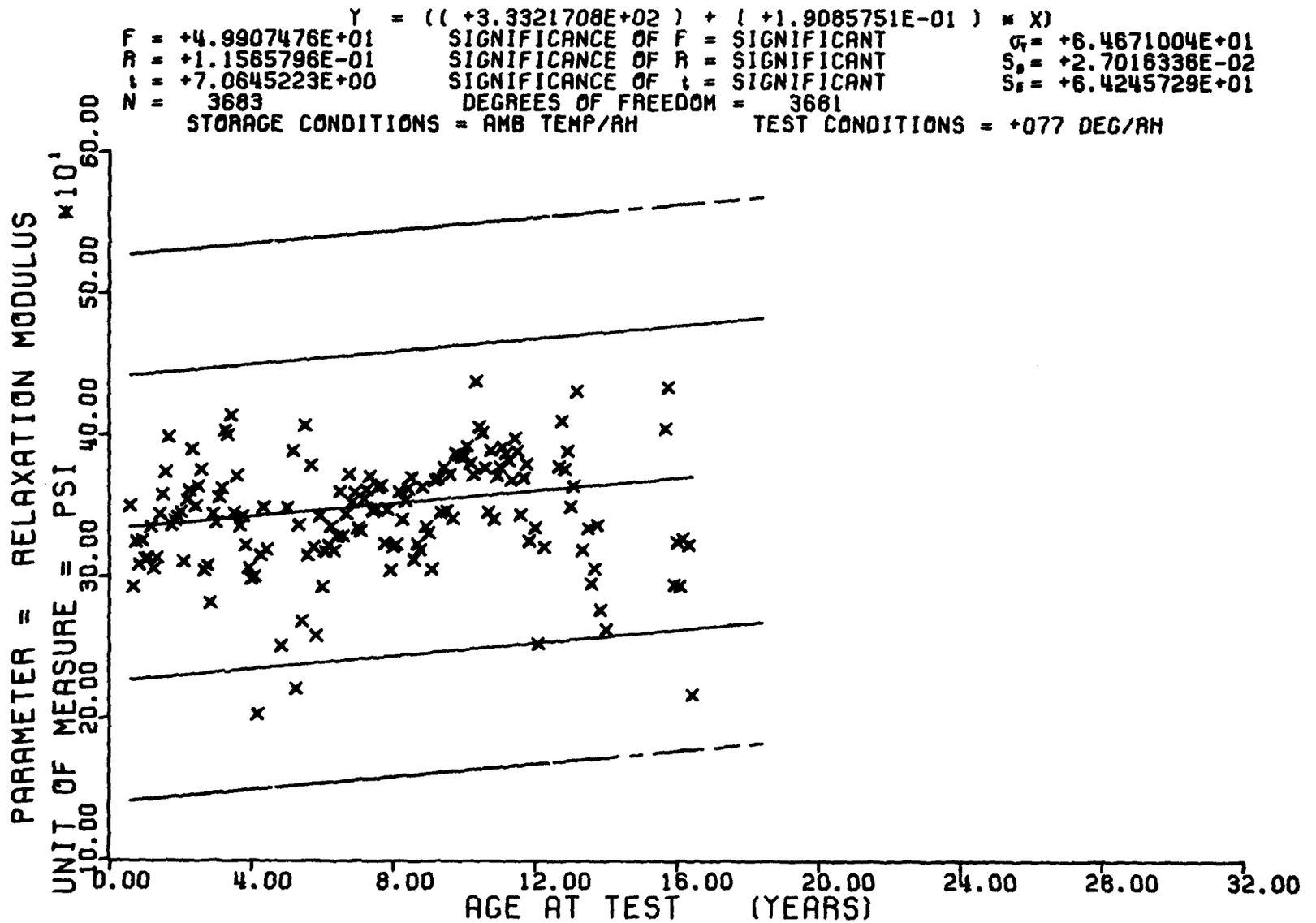

Y = ((+3.3321708E+02) + (+1.9085751E-01) * X)
F = +4.9907476E+01 SIGNIFICANCE OF F = SIGNIFICANT σr = +6.4671004E+01
R = +1.1565796E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +2.7016336E-02
t = +7.0645223E+00 SIGNIFICANCE OF t = SIGNIFICANT Sx = +6.4245729E+01
N = 3683 DEGREES OF FREEDOM = 3681
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = +077 DEG/RH
PARAMETER = RELAXATION MODULUS
UNIT OF MEASURE = PSI *10¹
10.00
20.00
30.00
40.00
50.00
60.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE I,WING 142,STRESS RELAXATION 5.0% 1000 SEC TEST TEMP. 77 DEG

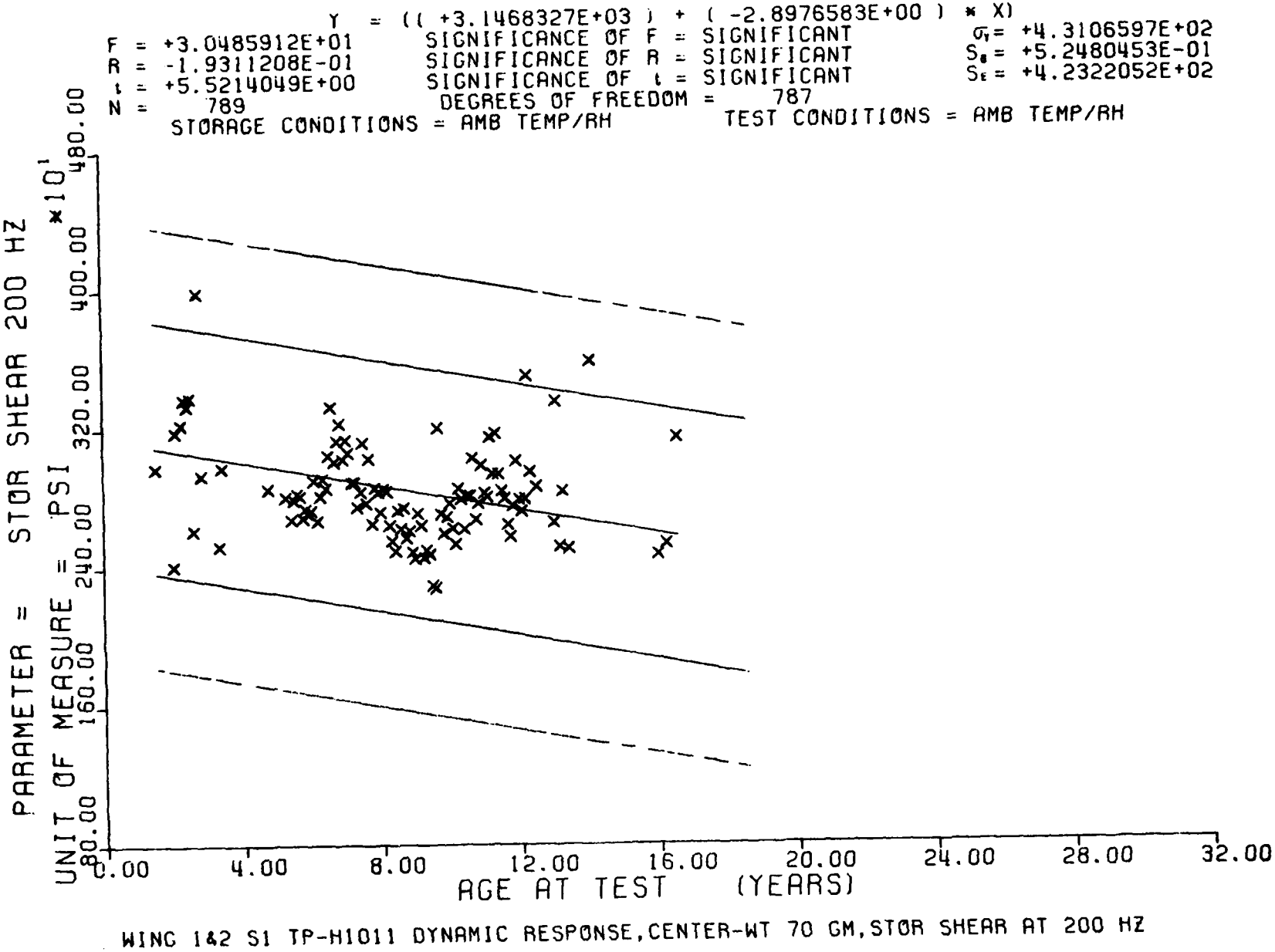
Figure 33

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
15	1	76	9	101	7	126	7	157	1
24	1	77	9	102	7	127	11	158	1
25	3	78	5	103	11	128	5	159	1
27	7	79	5	104	6	129	6	161	3
28	8	80	5	105	6	130	11	169	1
29	8	81	9	106	13	131	10	192	1
30	11	82	5	107	3	132	18	195	1
31	3	83	11	108	6	133	7	199	1
33	2	84	8	109	11	134	7		
34	3	85	6	110	12	135	9		
40	1	86	9	111	8	136	13		
41	1	87	14	112	4	137	11		
57	1	88	14	113	3	138	9		
63	3	89	13	114	6	139	5		
65	3	90	45	115	3	140	6		
66	2	91	33	116	20	141	8		
67	4	92	28	117	13	142	6		
68	3	93	23	118	8	143	5		
69	4	94	10	119	7	144	2		
70	7	95	7	120	11	145	2		
71	3	96	7	121	11	146	2		
72	7	97	9	122	6	147	2		
73	7	98	4	123	10	148	2		
74	3	99	4	124	9	150	1		
75	7	100	9	125	4	156	1		

WING 162 S1 TP-H1011 DYNAMIC RESPONSE,CENTER-WT 70 GM,STCR SHEAR AT 200 HZ

This sample size summary is applicable to figure 34



WING 1&2 S1 TP-H1011 DYNAMIC RESPONSE,CENTER-WT 70 GM,STOR SHEAR AT 200 HZ

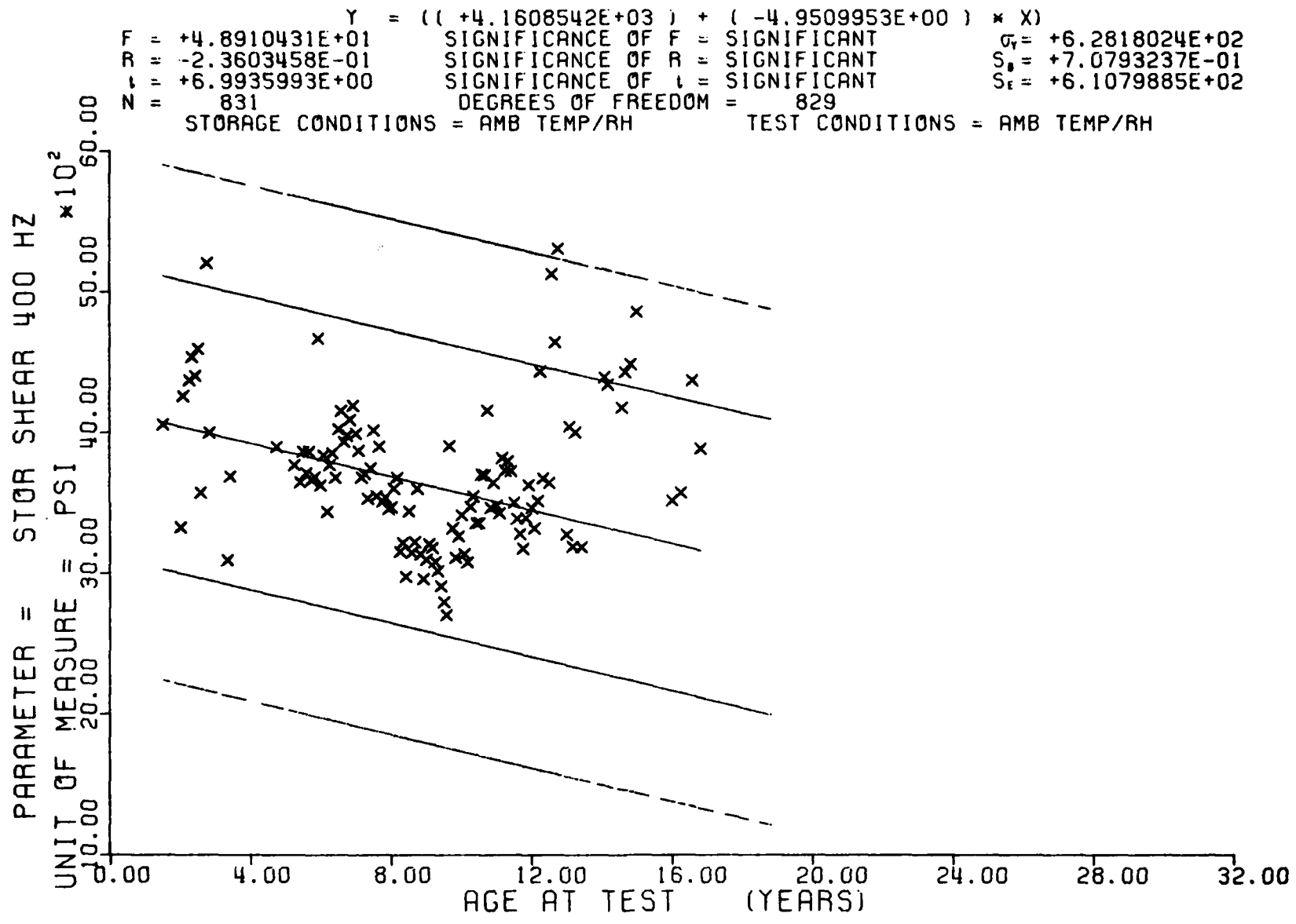
Figure 34

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
23	1	76	9	101	7	126	9	152	2
24	1	77	9	102	7	127	13	153	2
25	5	78	5	103	11	128	5	156	1
27	7	79	5	104	6	129	8	157	1
28	6	80	5	105	6	130	11	158	1
29	8	81	9	106	13	131	10	159	3
30	11	82	9	107	3	132	18	161	3
31	5	83	13	108	8	133	9	169	1
33	2	84	8	109	11	134	7	170	2
34	3	85	6	110	12	135	11	175	1
40	1	86	9	111	10	136	13	176	1
41	1	87	14	112	4	137	13	178	2
57	1	88	14	113	4	138	9	180	1
63	5	89	13	114	6	139	5	192	1
65	3	90	45	115	3	140	6	195	1
66	2	91	33	116	20	141	8	199	1
67	4	92	28	117	13	142	6	202	2
68	3	93	24	118	8	143	5		
69	4	94	10	119	7	144	2		
70	7	95	7	120	11	145	2		
71	6	96	7	121	11	146	2		
72	7	97	9	122	6	147	2		
73	7	98	4	123	10	148	2		
74	3	99	4	124	9	150	1		
75	7	100	9	125	4	151	2		

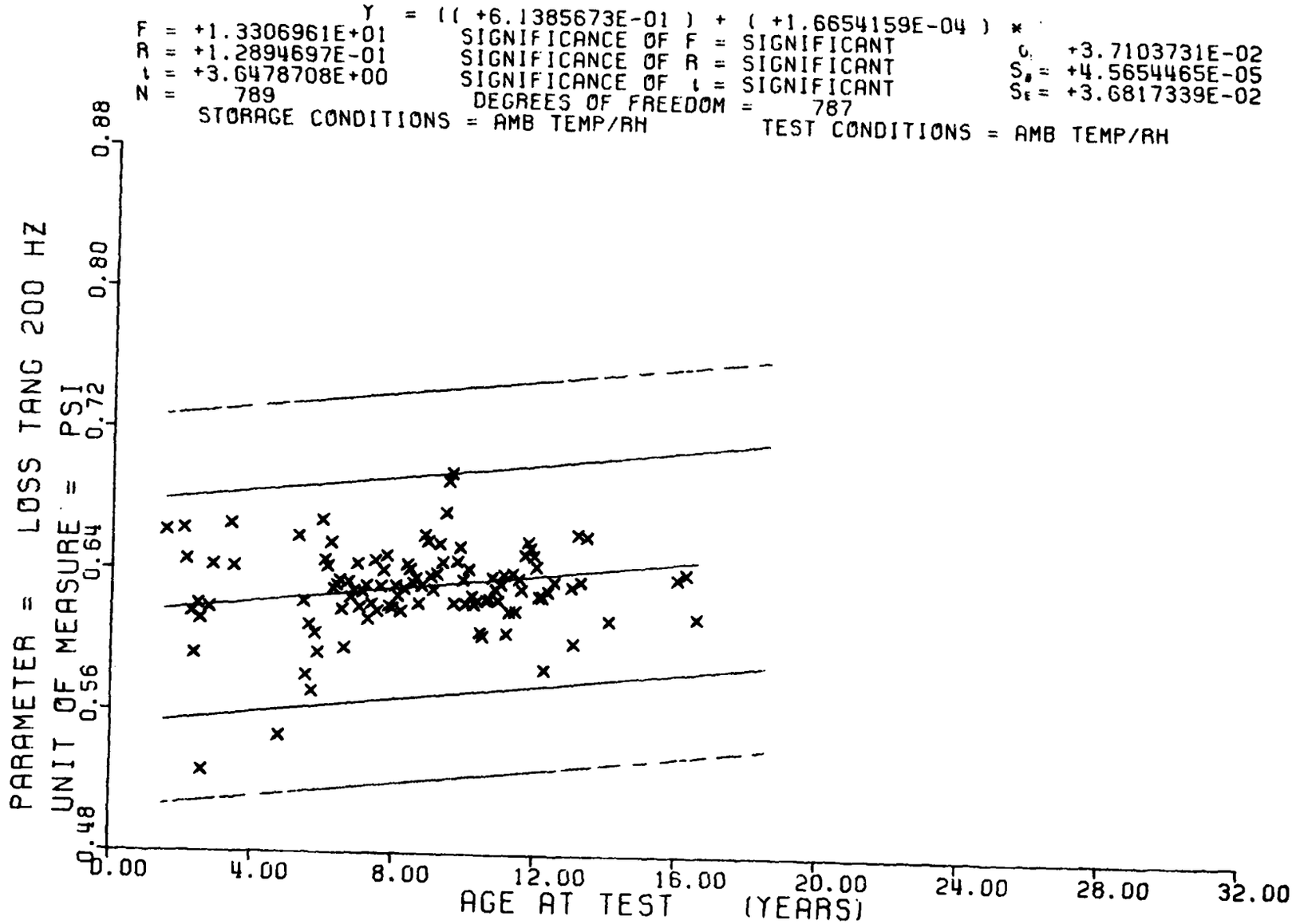
WING 162 S1 TP-H1011 DYNAMIC RESPONSE,CENTER-WT 70 GM,STOR SHEAR AT 400 HZ

This sample size summary is applicable to figure 35, 36 and 37



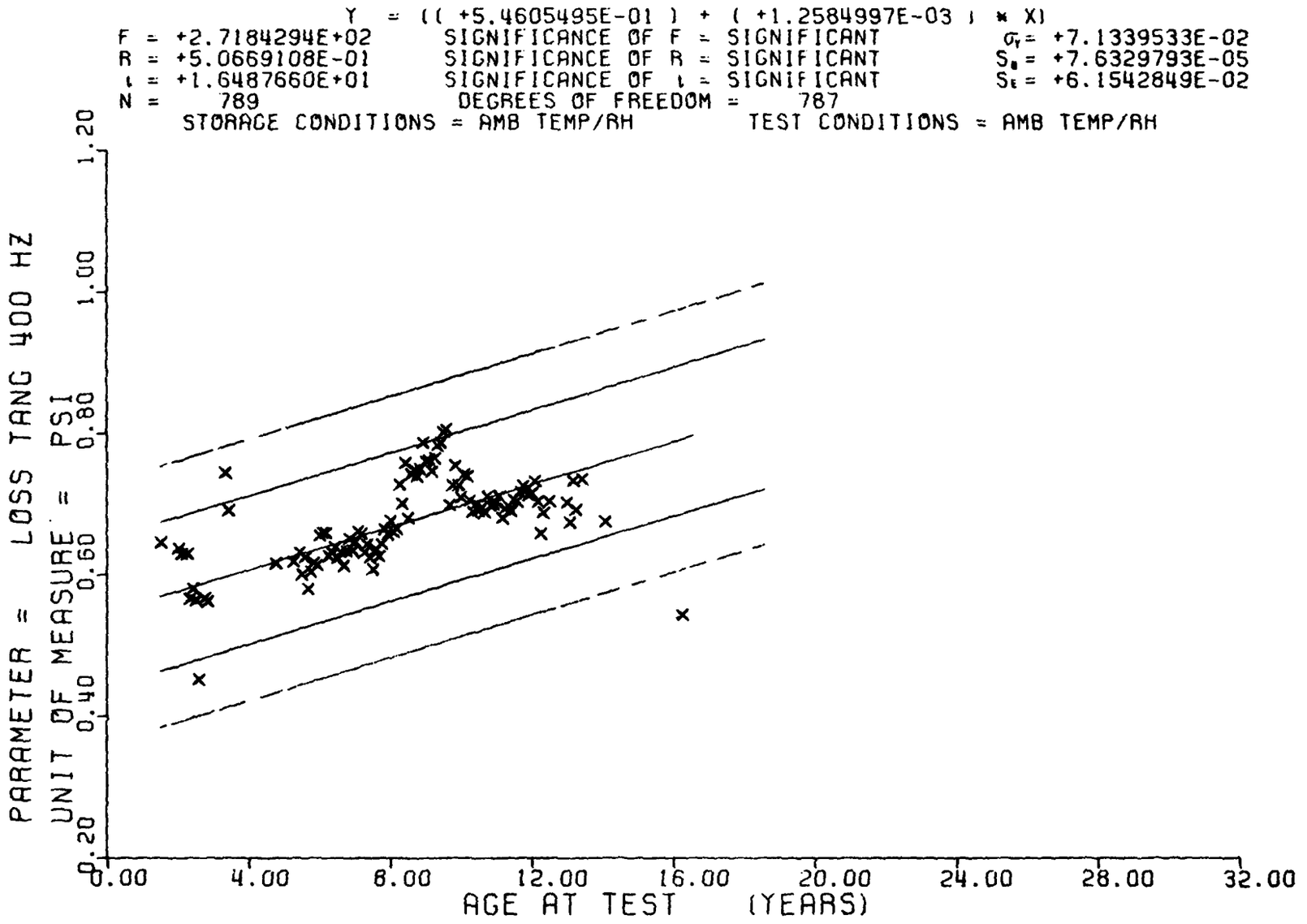
WING 1&2 S1 TP-H1011 DYNAMIC RESPONSE,CENTER-WT 70 GM,STOR SHEAR AT 400 HZ

Figure 35



S1 WING 1&2 TP-H1011 DYNAMIC RESPONSE LOSS TANGENT AT 200 HZ,CENTER-WT 70 GM

Figure 36



S1 WING 1&2 TP-H1011 DYNAMIC RESPONSE LOSS TANGENT AT 400 HZ,CENTER-WT 70 GM

Figure 37

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
2	1	31	24	56	1	88	15	113	30
7	1	32	18	64	2	89	24	114	15
8	3	33	14	65	1	90	11	115	18
9	3	34	9	66	3	91	9	116	21
10	5	35	9	67	3	92	32	117	15
11	3	36	6	68	8	93	25	118	18
12	8	37	9	69	2	94	39	119	33
13	5	38	3	70	6	95	47	120	21
14	9	39	9	71	4	96	63	121	18
15	15	40	5	72	6	97	37	122	12
16	13	41	8	73	1	98	34	123	6
17	4	42	6	74	6	99	45	124	6
18	14	43	12	75	4	100	36	125	3
19	6	44	11	76	5	101	25		
20	10	45	27	77	5	102	19		
21	10	46	28	78	4	103	36		
22	12	47	30	79	4	104	3		
23	11	48	26	80	7	105	33		
24	8	49	21	81	6	106	21		
25	16	50	18	82	7	107	22		
26	24	51	14	83	10	108	12		
27	28	52	7	84	2	109	21		
28	21	53	2	85	12	110	15		
29	28	54	3	86	11	111	9		
30	27	55	3	87	5	112	18		

STAGE 1 WING 1&2 TP-H1011 CONSTANT STRAIN

This sample size summary is applicable to figure 38

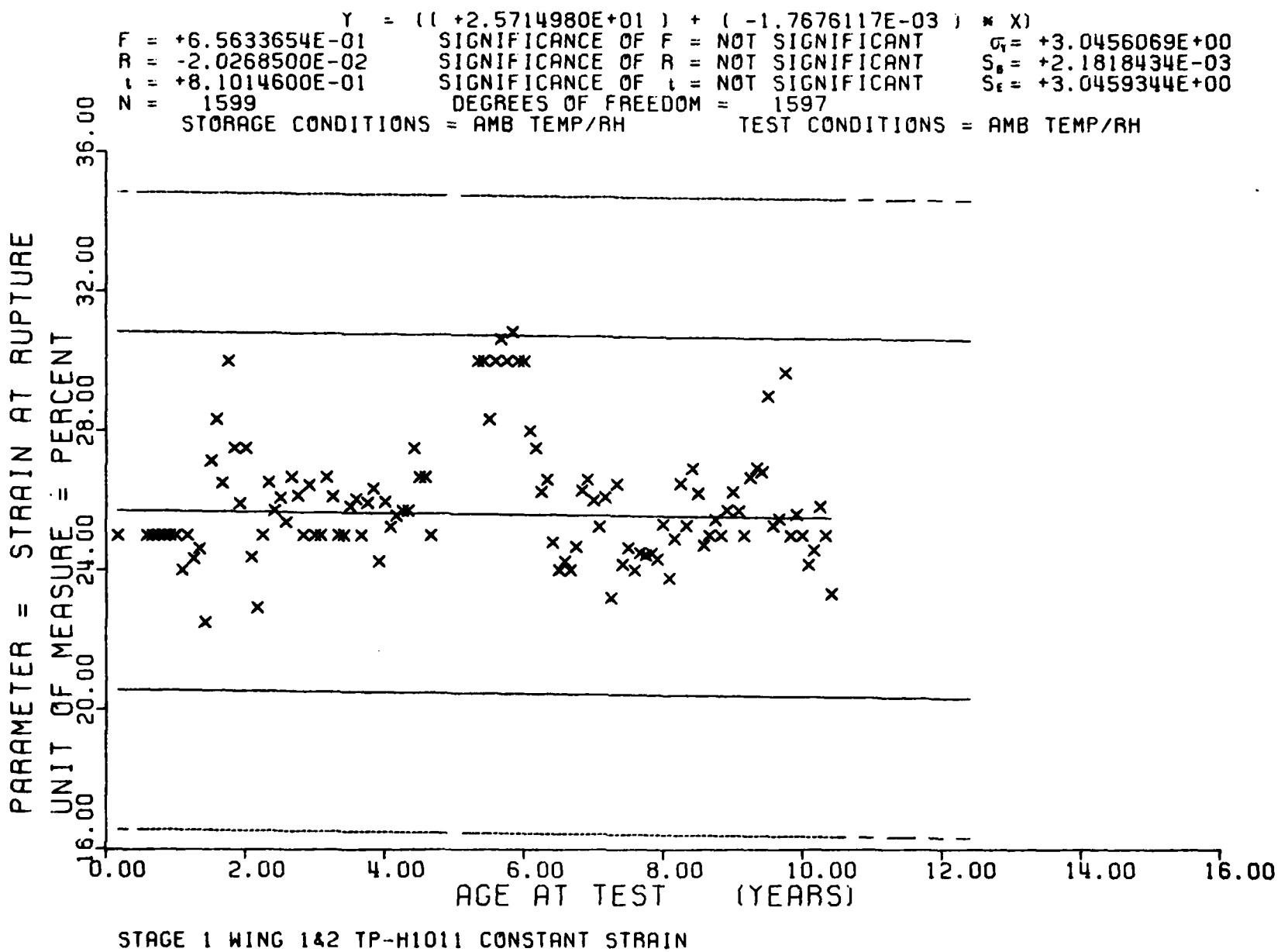

Y = ((+2.5714980E+01) + (-1.7676117E-03) * X)
F = +6.5633654E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ1 = +3.0456069E+00
R = -2.0268500E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT Sb = +2.1818434E-03
t = +8.1014600E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT Sε = +3.0459344E+00
N = 1599 DEGREES OF FREEDOM = 1597
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = PERCENT
36.00
32.00
28.00
24.00
20.00
16.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
AGE AT TEST (YEARS)
STAGE 1 WING 1&2 TP-H1011 CONSTANT STRAIN

Figure 38

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
90	3	117	19	142	24	197	3
91	3	118	24	143	33	198	3
92	3	119	43	144	18		
93	9	120	29	145	15		
94	9	121	20	146	3		
95	3	122	15	147	6		
97	3	123	13	148	3		
98	3	124	18	150	3		
99	9	125	9	152	18		
101	9	126	21	153	12		
102	6	127	18	154	15		
103	21	128	24	155	19		
104	9	129	30	156	9		
105	9	130	30	157	3		
106	9	131	24	158	3		
107	24	132	9	159	3		
108	12	133	12	161	6		
109	24	134	24	164	6		
110	3	135	12	165	3		
111	9	136	24	167	6		
112	3	137	21	169	6		
113	24	138	30	190	3		
114	9	139	41	193	6		
115	21	140	9	194	6		
116	18	141	24	196	3		

WING 162 STAGE 1 TP-H1011 THERMAL COEFFICIENT OF LINEAR EXPANSION BELOW TG

This sample size summary is applicable to figures 39 and 40

Y = ((+4.6827827E-05) + (+7.3891082E-08) * X)

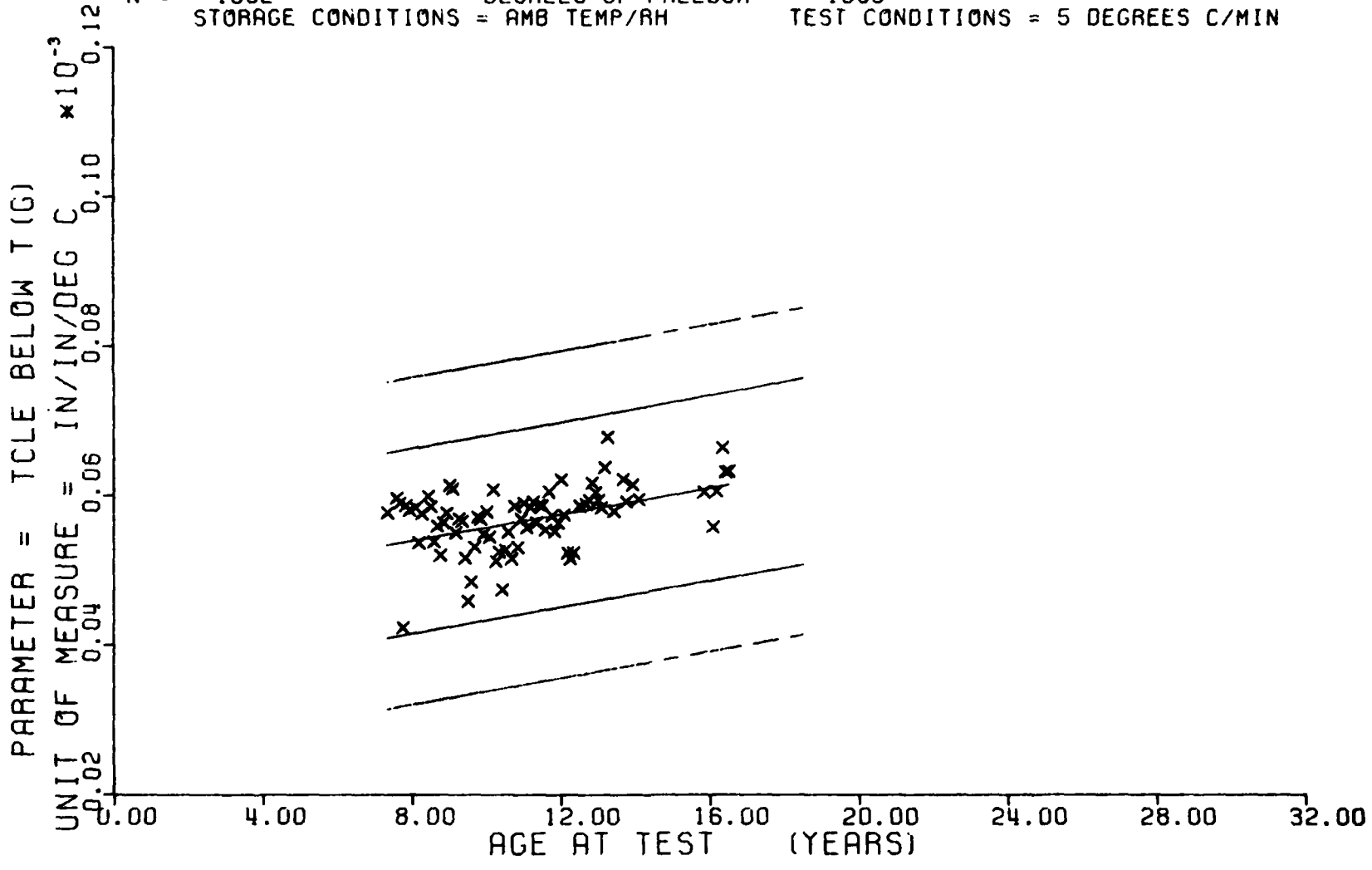
F = +3.9437596E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +7.4320388E-06

R = +1.9203371E-01 SIGNIFICANCE OF R = SIGNIFICANT S_θ = +1.1766215E-08

t = +6.2799360E+00 SIGNIFICANCE OF t = SIGNIFICANT S_ε = +7.2972560E-06

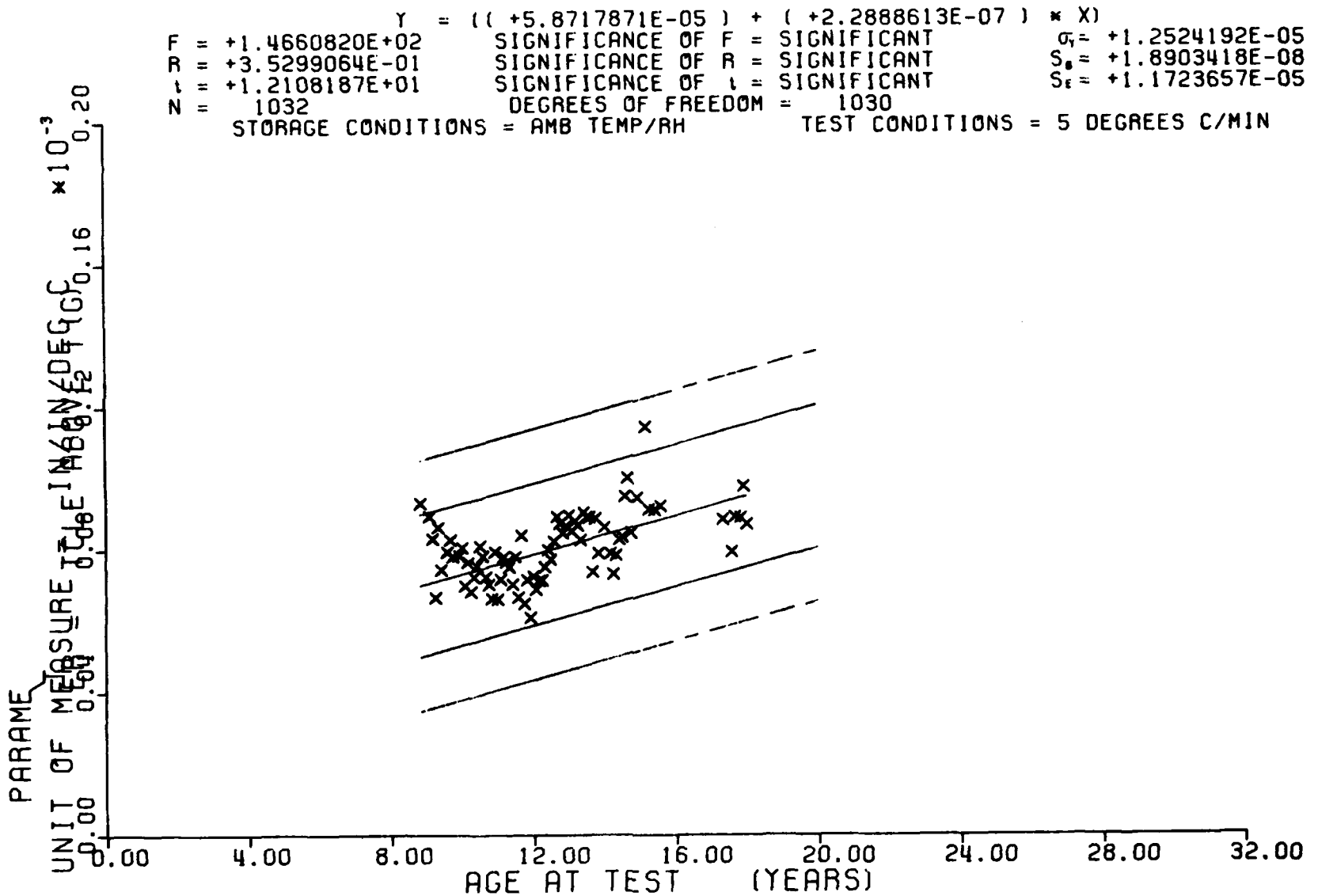
N = 1032 DEGREES OF FREEDOM = 1030

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 5 DEGREES C/MIN



WING 1&2 STAGE 1 TP-H1011 THERMAL COEFFICIENT OF LINEAR EXPANSION BELOW TG

Figure 39



WING 1&2 STAGE 1 TP-H1011, THERMAL COEFFICIENT OF LINEAR EXPANSION ABOVE TG

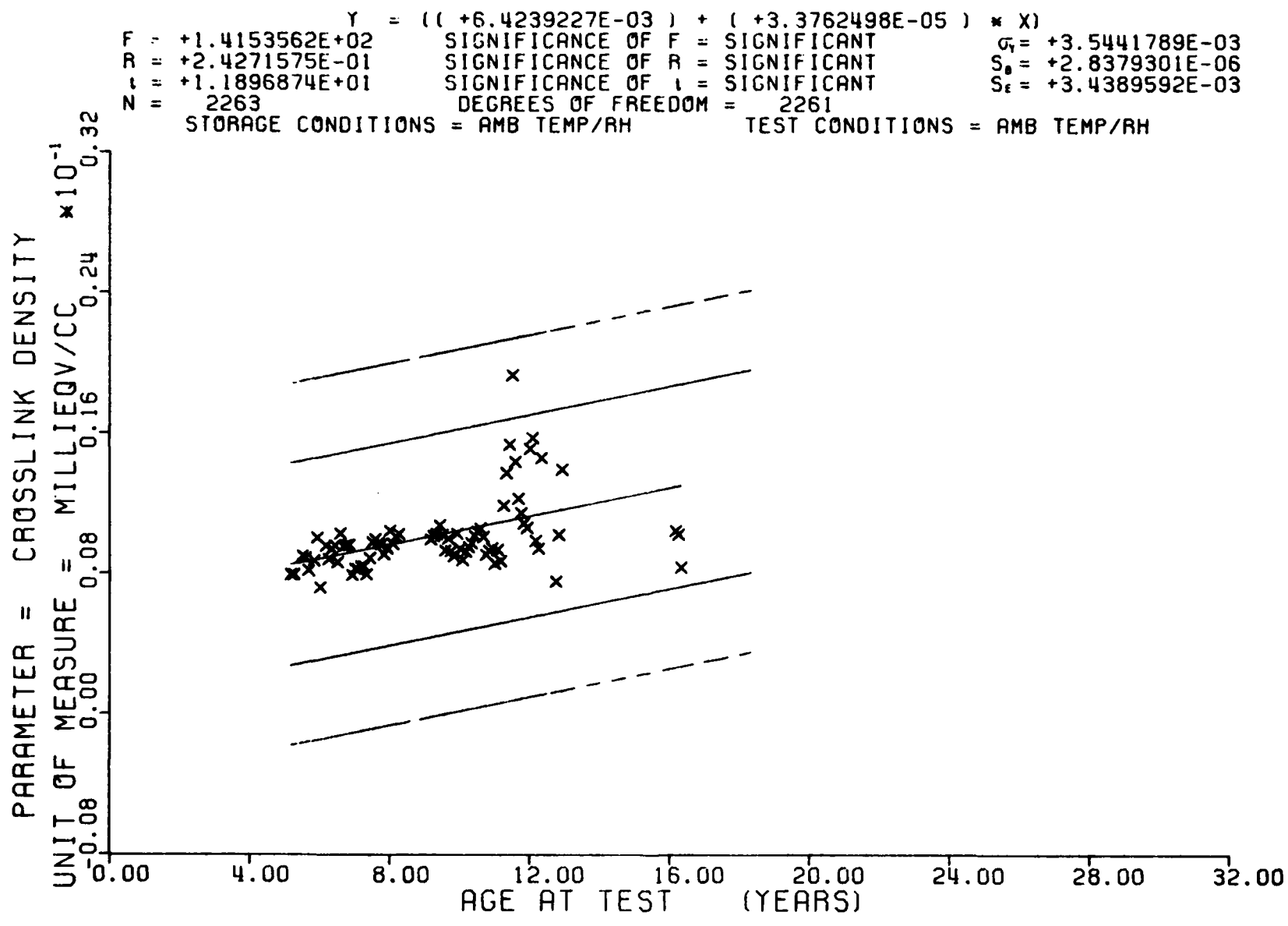
Figure 40

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
62	4	91	72	126	28	155	28
63	8	92	103	127	45	194	8
66	4	93	108	128	24	195	24
67	8	94	130	129	21	196	4
68	12	95	64	130	8		
70	4	96	59	131	20		
71	4	97	19	132	16		
72	8	98	24	133	12		
74	56	99	12	134	4		
75	8	110	28	135	8		
76	16	111	40	136	36		
77	20	112	32	137	32		
78	36	113	15	138	20		
79	20	114	36	139	20		
80	56	115	16	140	40		
81	56	116	24	141	28		
82	40	117	8	142	52		
83	24	118	16	143	40		
84	24	119	16	144	12		
85	24	120	28	145	12		
86	32	121	20	146	12		
87	20	122	56	147	4		
88	4	123	40	148	4		
89	72	124	28	153	12		
90	68	125	48	154	36		

STAGE 1, WING 162, TP-H1011, SOL GEL, CROSSLINK DENSITY

This sample size summary is applicable to figure 41



STAGE 1, WING 1&2, TP-H1011, SOL GEL, CROSSLINK DENSITY

Figure 41

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
62	4	91	72	116	40	141	28
63	8	92	103	117	12	142	52
66	4	93	108	118	32	143	39
67	8	94	130	119	16	144	12
68	12	95	84	120	28	145	12
70	4	96	55	121	20	146	12
71	4	97	19	122	56	147	4
72	3	98	24	123	40	148	4
74	36	99	12	124	28	153	12
75	8	100	16	125	48	154	36
76	16	101	32	126	27	155	28
77	20	102	16	127	44	194	8
78	36	103	8	128	24	195	24
79	20	104	12	129	21	196	4
80	36	105	12	130	8		
81	56	106	20	131	20		
82	40	107	32	132	16		
83	24	108	24	133	12		
84	24	109	32	134	4		
85	24	110	16	135	8		
86	32	111	24	136	36		
87	20	112	20	137	32		
88	4	113	20	138	19		
89	72	114	20	139	28		
90	68	115	16	140	40		

STAGE 1,WING 162,SOL GEL, % EXTRACTABLE,TPH-1011

This sample size summary is applicable to figure 42

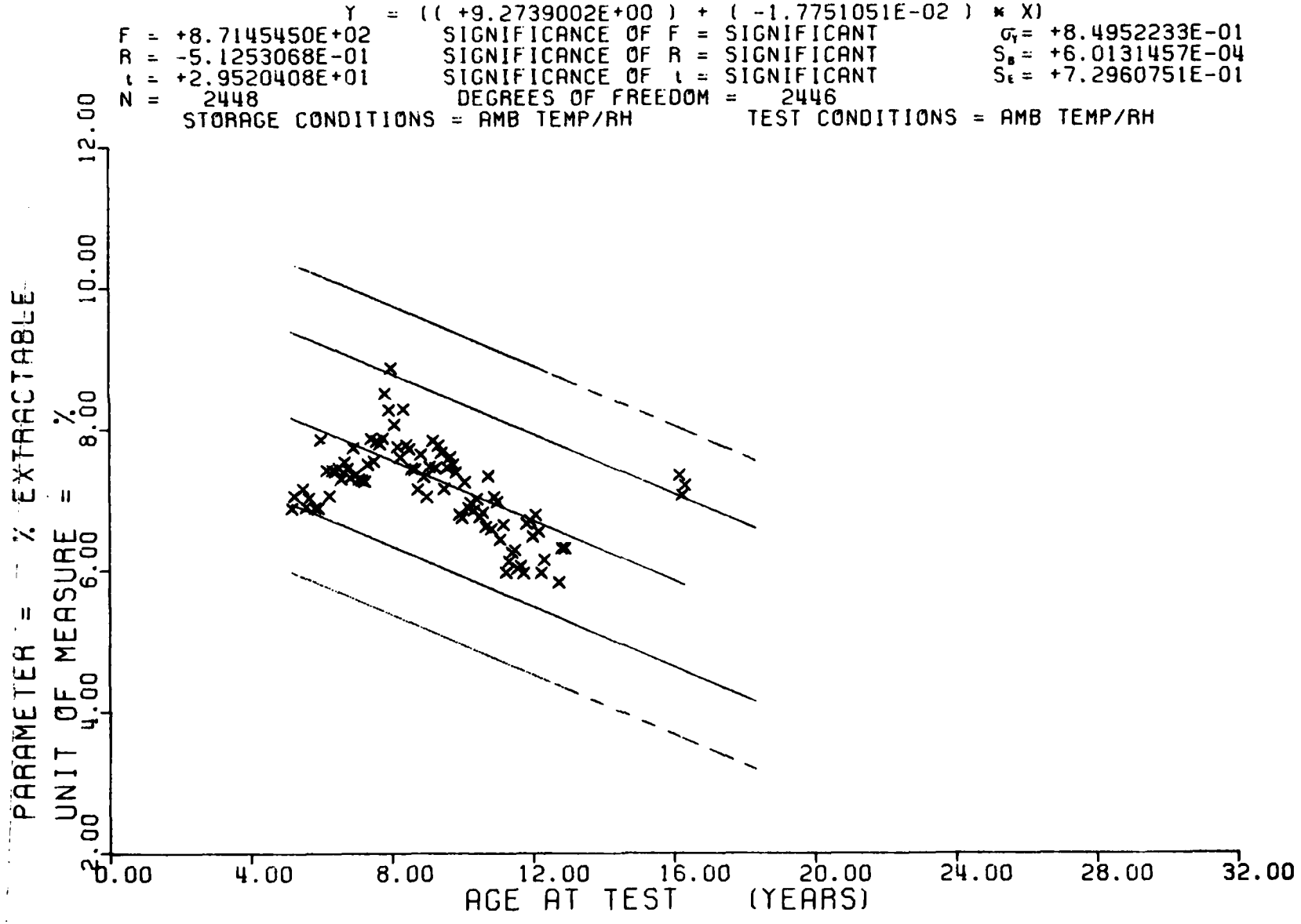

Y = ((+9.2739002E+00) + (-1.7751051E-02) * X)
F = +8.7145450E+02 SIGNIFICANCE OF F = SIGNIFICANT σr = +8.4952233E-01
R = -5.1253068E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +6.0131457E-04
t = +2.9520408E+01 SIGNIFICANCE OF t = SIGNIFICANT St = +7.2960751E-01
N = 2448 DEGREES OF FREEDOM = 2446
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = % EXTRACTABLE
UNIT OF MEASURE = %
12.00
10.00
8.00
6.00
4.00
2.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2,SOL GEL, % EXTRACTABLE,TPH-1011

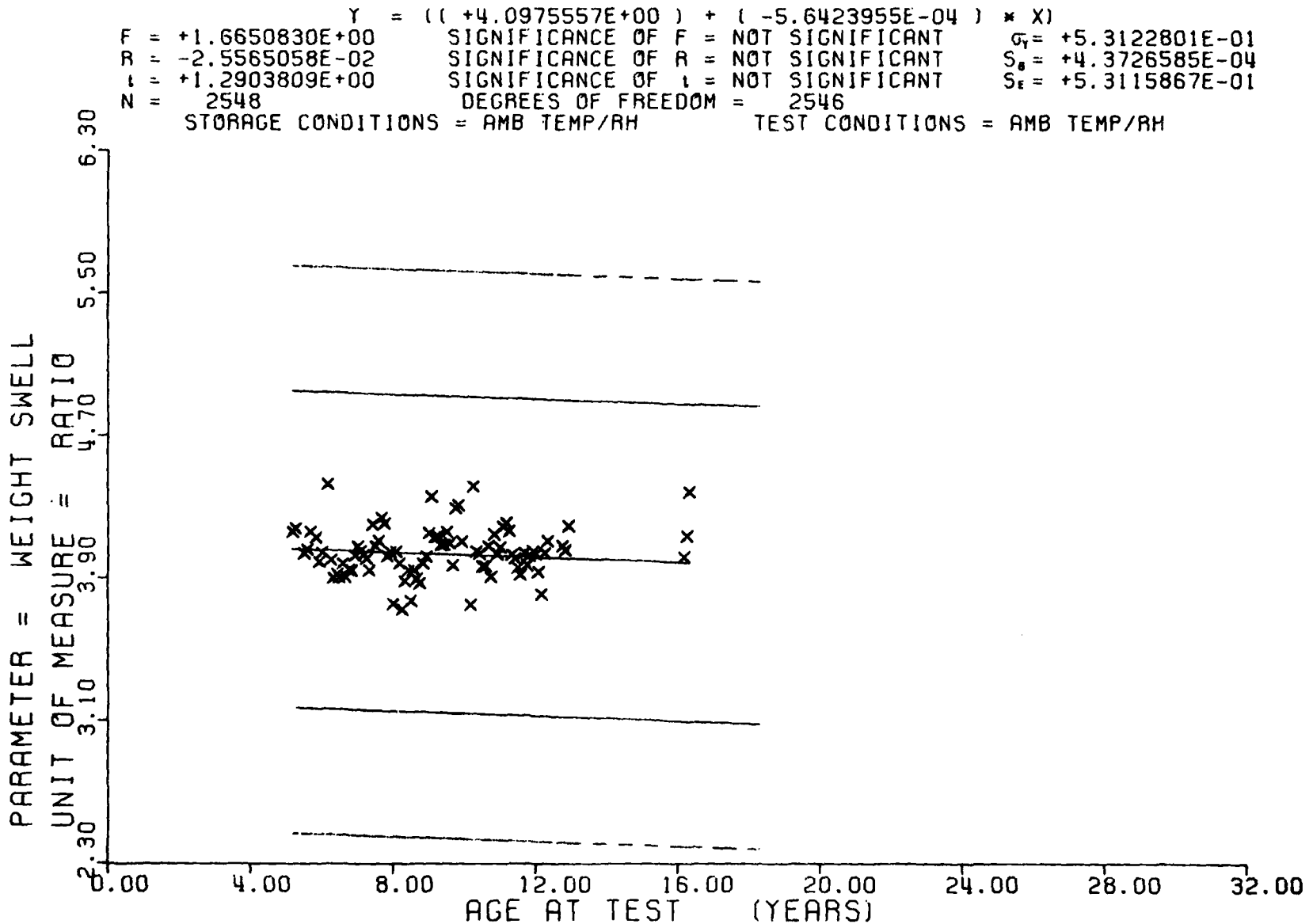
Figure 42

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
62	4	91	72	116	48	141	28
63	8	92	103	117	12	142	52
66	4	93	108	118	32	143	40
67	8	94	130	119	16	144	12
68	12	95	84	120	28	145	12
70	4	96	59	121	20	146	12
71	4	97	19	122	56	147	4
72	3	98	24	123	40	148	4
74	36	99	12	124	28	153	12
75	8	100	16	125	48	154	36
76	16	101	32	126	27	155	28
77	20	102	16	127	44	194	8
78	36	103	8	128	24	195	24
79	20	104	12	129	21	196	4
80	36	105	12	130	8		
81	36	106	20	131	20		
82	40	107	32	132	16		
83	24	108	24	133	12		
84	24	109	36	134	4		
85	24	110	28	135	8		
86	32	111	40	136	36		
87	20	112	32	137	32		
88	4	113	36	138	19		
89	72	114	40	139	28		
90	68	115	28	140	40		

STAGE 1, WING 182, TP-H1011, SOL GEL, WT. SWELL RATIO

This sample size summary is applicable to figure 43



STAGE 1, WING 1&2, TP-H1011, SOL GEL, WT. SWELL RATIO

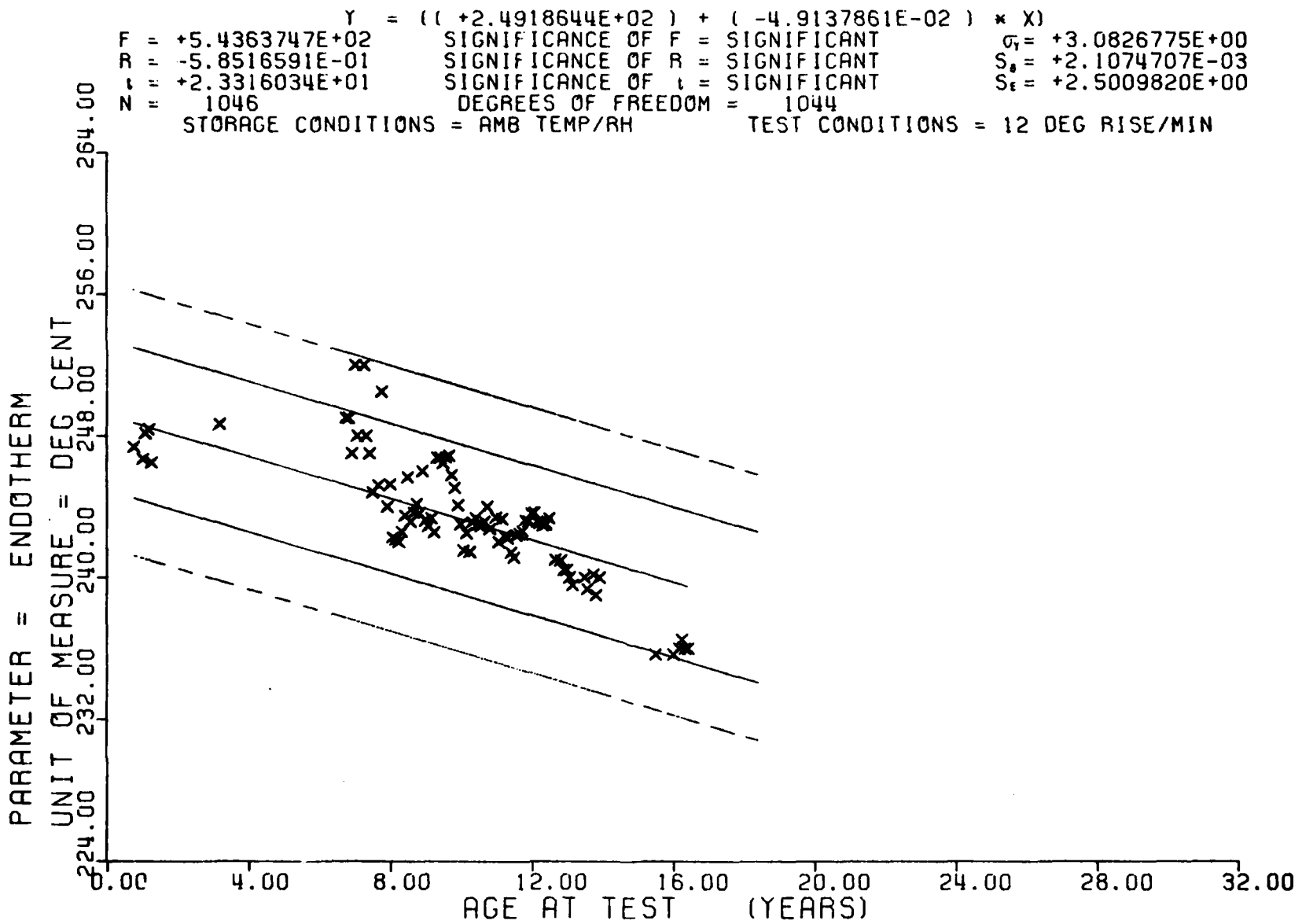
Figure 43

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
9	16	103	21	128	6	156	12
12	24	104	12	129	3	157	6
13	12	105	6	130	4	158	9
14	16	106	27	132	5	162	3
15	8	107	9	133	4	163	3
80	3	108	9	134	16	165	6
81	1	109	11	135	25	166	6
82	1	110	23	136	25	167	3
83	1	111	11	137	29	186	3
84	1	112	17	138	45	192	3
85	2	113	34	139	38	194	3
87	1	114	11	140	21	195	6
88	1	115	19	141	6	196	3
89	1	116	18	142	8	197	6
90	5	117	14	143	22		
92	5	118	17	144	11		
93	4	119	24	145	12		
95	4	120	18	146	21		
96	12	121	21	147	12		
97	16	122	6	148	17		
98	21	123	9	149	3		
99	9	124	17	150	6		
100	17	125	11	152	6		
101	14	126	3	154	24		
102	9	127	12	155	21		

STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, ENDOTHERM

This sample size summary is applicable to figures 44 and 45



STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, ENDOTHERM

Figure 44

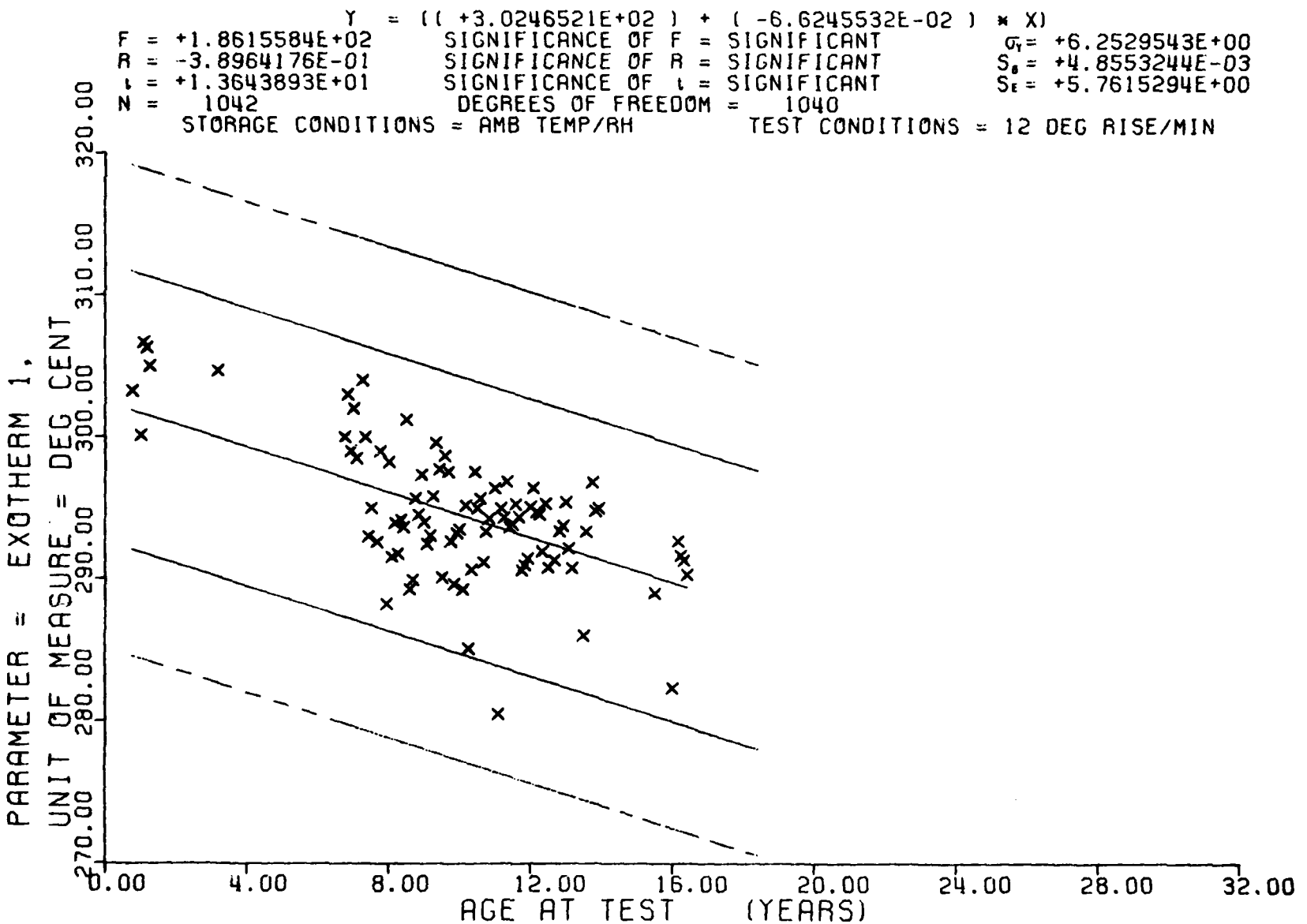

Y = ((+3.0246521E+02) + (-6.6245532E-02) * X)
F = +1.8615584E+02 SIGNIFICANCE OF F = SIGNIFICANT σY = +6.2529543E+00
R = -3.8964176E-01 SIGNIFICANCE OF R = SIGNIFICANT Sθ = +4.8553244E-03
ι = +1.3643893E+01 SIGNIFICANCE OF ι = SIGNIFICANT Sε = +5.7615294E+00
N = 1042 DEGREES OF FREEDOM = 1040
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 12 DEG RISE/MIN
PARAMETER = EXOTHERM 1,
UNIT OF MEASURE = DEG CENT
320.00
310.00
300.00
290.00
280.00
270.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, EXOTHERM #1

Figure 45

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
9	16	103	18	128	6	156	9
12	24	104	10	129	3	157	6
13	12	105	4	130	4	158	9
14	16	106	23	132	5	162	3
15	8	107	8	133	4	163	3
33	3	108	9	134	16	165	6
61	1	109	8	135	23	166	6
62	1	110	16	136	25	167	3
63	1	111	11	137	29	186	3
64	1	112	15	138	42	192	3
65	2	113	34	139	37	194	3
87	1	114	10	140	20	195	6
88	1	115	19	141	8	196	3
89	1	116	18	142	8	197	6
90	4	117	13	143	20		
92	5	118	13	144	11		
93	4	119	22	145	12		
95	4	120	18	146	21		
96	6	121	20	147	12		
97	10	122	6	148	17		
98	14	123	8	149	3		
99	6	124	16	150	6		
100	12	125	11	152	6		
101	13	126	3	154	20		
102	9	127	12	155	17		

STAGE 1,WING 162,CTA,12 DEG C RISE/MIN, EXOTHERM #2

This sample size summary is applicable to figure 46

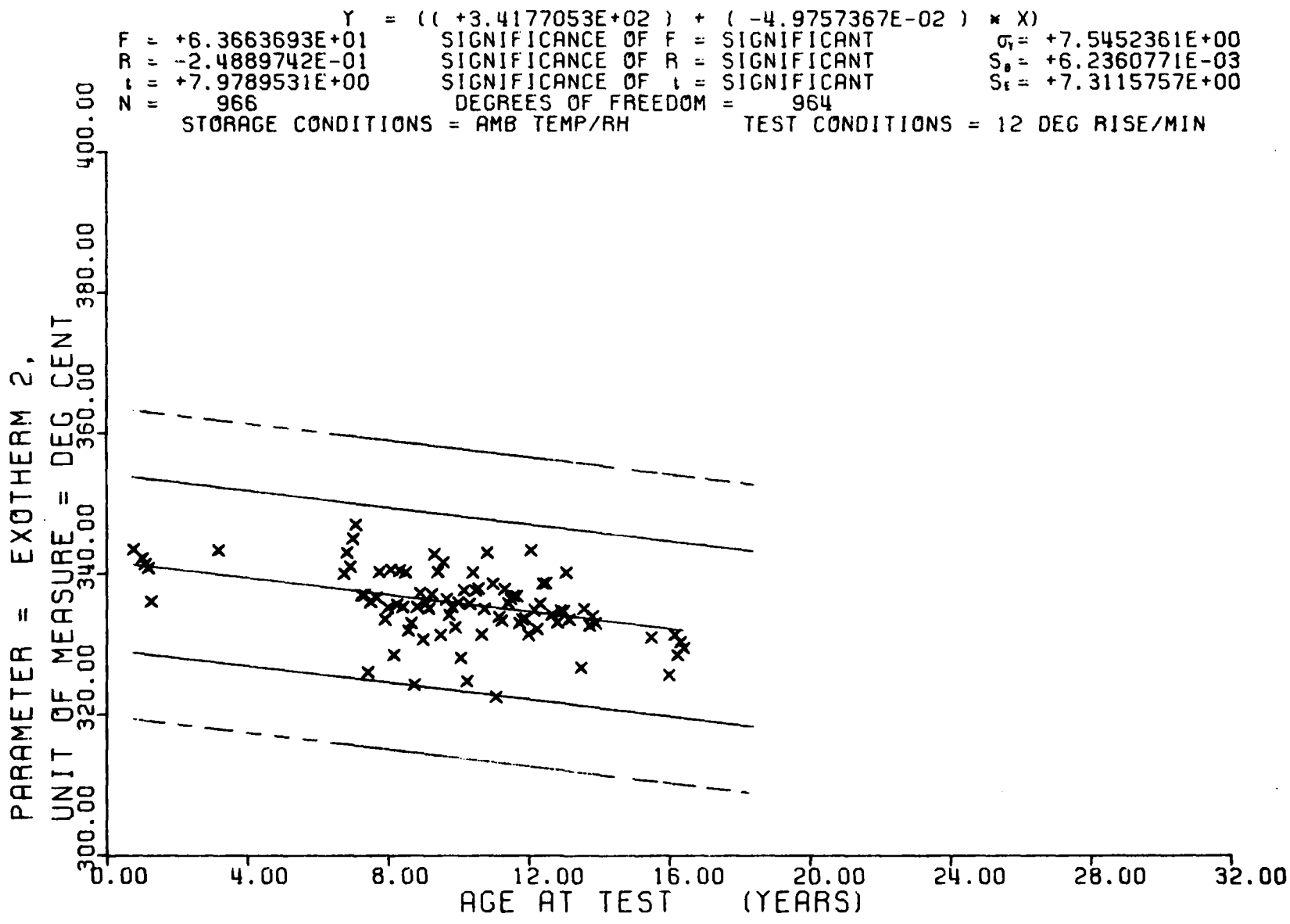

Y = ((+3.4177053E+02) + (-4.9757367E-02) * X)
F = +6.3663693E+01 SIGNIFICANCE OF F = SIGNIFICANT σ1 = +7.5452361E+00
R = -2.4889742E-01 SIGNIFICANCE OF R = SIGNIFICANT Sθ = +6.2360771E-03
t = +7.9789531E+00 SIGNIFICANCE OF t = SIGNIFICANT St = +7.3115757E+00
N = 966 DEGREES OF FREEDOM = 964
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 12 DEG RISE/MIN
PARAMETER = EXOTHERM 2,
UNIT OF MEASURE = DEG CENT
400.00
380.00
360.00
340.00
320.00
300.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, EXOTHERM #2

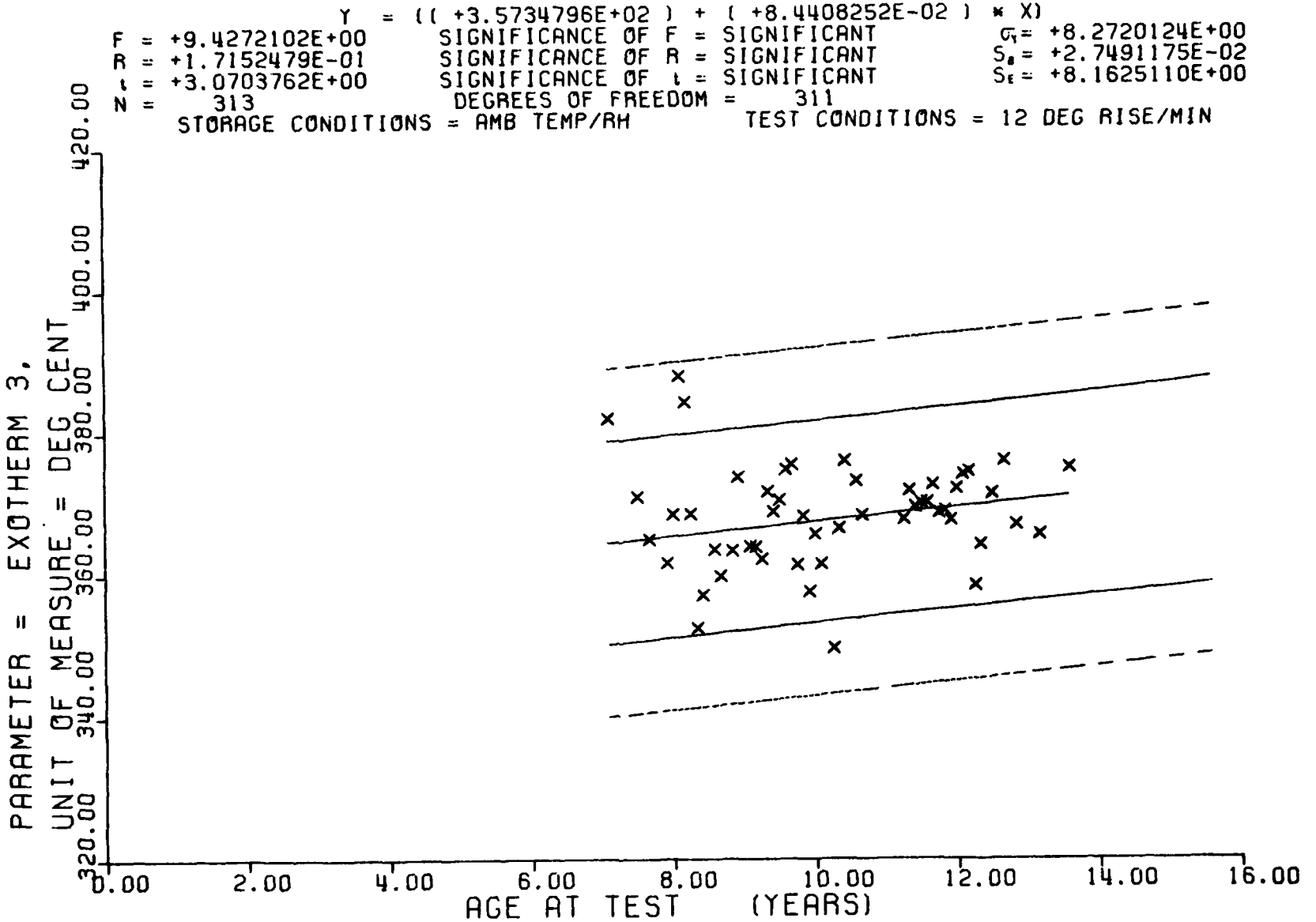
Figure 46

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
89	1	120	7	163	1
90	1	121	2		
92	2	123	3		
95	3	124	10		
96	2	125	1		
97	3	127	5		
98	3	128	6		
99	5	135	11		
100	2	136	9		
101	7	137	12		
103	7	138	19		
104	5	139	19		
106	5	140	10		
107	4	141	6		
109	7	142	8		
110	13	143	9		
111	5	144	8		
112	7	145	8		
113	11	146	6		
114	4	147	2		
115	5	148	8		
116	2	150	5		
117	5	152	2		
118	11	154	1		
119	10	158	5		

STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, EXOTHERM #3

This sample size summary is applicable to figure 47



STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, EXOTHERM #3

Figure 47

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
[illegible]	16	103	20	129	3	156	4
12	24	104	11	130	2	162	3
13	12	105	6	132	5	163	2
14	16	106	23	134	14	165	6
15	8	107	9	135	16	166	6
38	3	108	9	136	15	167	3
81	1	109	7	137	19	186	3
82	1	110	15	138	27	192	3
83	1	111	7	139	25	194	3
84	1	112	14	140	11	195	6
85	2	113	23	141	6	196	3
87	1	114	8	142	2	197	6
88	1	115	17	143	15		
89	1	116	16	144	6		
90	5	117	10	145	6		
92	4	118	11	146	14		
93	4	119	18	147	9		
95	2	120	11	148	17		
96	12	121	20	149	3		
97	13	122	3	150	4		
98	20	123	7	152	4		
99	6	124	9	154	24		
100	15	125	10	155	21		
101	8	126	3	156	12		
102	9	127	8	157	6		

STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, IGNITION

This sample size summary is applicable to figure 48

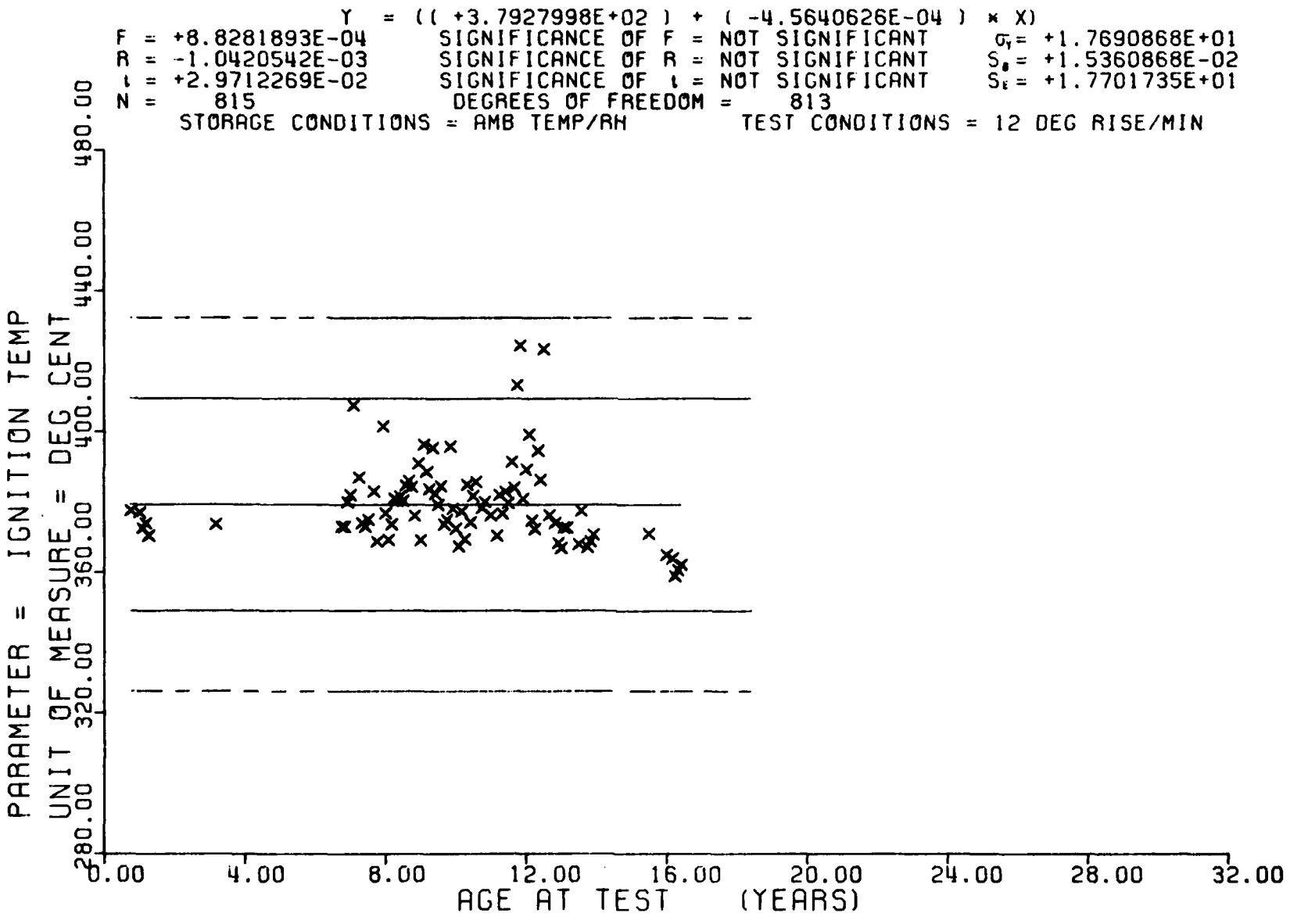

Y = ((+3.7927998E+02) + (-4.5640626E-04) × X)
F = +8.8281893E-04 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.7690868E+01
R = -1.0420542E-03 SIGNIFICANCE OF R = NOT SIGNIFICANT S_β = +1.5360868E-02
t = +2.9712269E-02 SIGNIFICANCE OF t = NOT SIGNIFICANT S_ε = +1.7701735E+01
N = 815 DEGREES OF FREEDOM = 813
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 12 DEG RISE/MIN
PARAMETER = IGNITION TEMP
UNIT OF MEASURE = DEG CENT
480.00
440.00
400.00
360.00
320.00
280.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
STAGE 1,WING 1&2,DTA,12 DEG C RISE/MIN, IGNITION

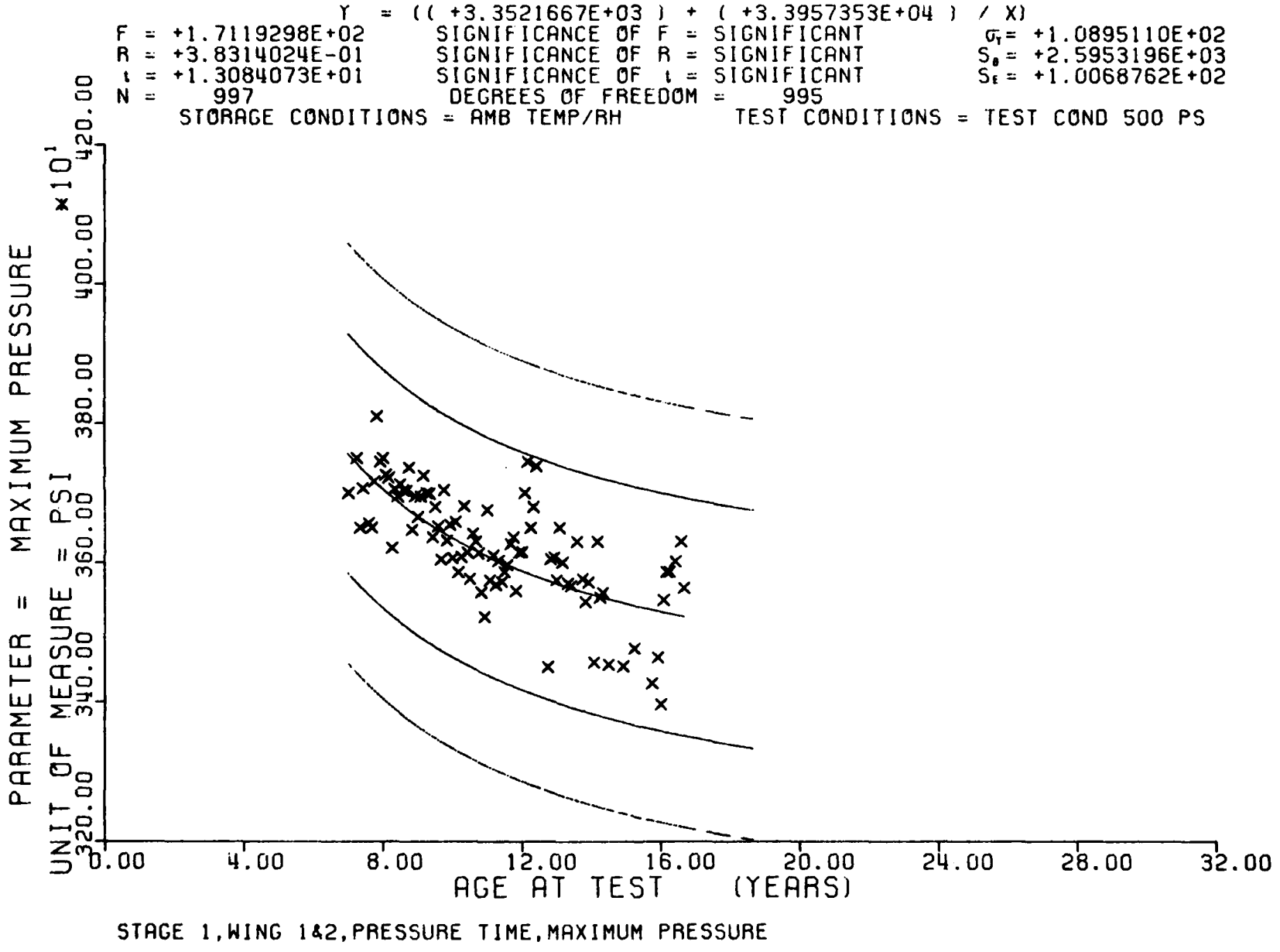
Figure 48

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
84	2	112	9	137	47	169	3
87	1	113	11	138	24	170	6
88	2	114	4	139	17	171	3
89	3	115	25	140	26	172	3
91	3	116	15	141	12	174	3
92	1	117	17	142	24	179	9
93	3	118	23	143	16	183	3
94	2	119	18	144	7	189	3
95	2	120	19	145	3	191	12
96	1	121	12	146	4	192	3
97	5	122	10	147	2	193	15
98	5	123	36	148	2	194	3
99	8	124	15	149	3	195	6
100	7	125	30	153	3	197	6
101	10	126	24	154	6	199	3
102	8	127	39	155	15	200	3
103	5	128	30	156	24		
104	10	129	27	157	3		
105	6	130	21	158	3		
106	7	131	27	160	3		
107	11	132	15	161	3		
108	16	133	10	163	6		
109	16	134	14	165	6		
110	4	135	19	166	6		
111	4	136	29	167	6		

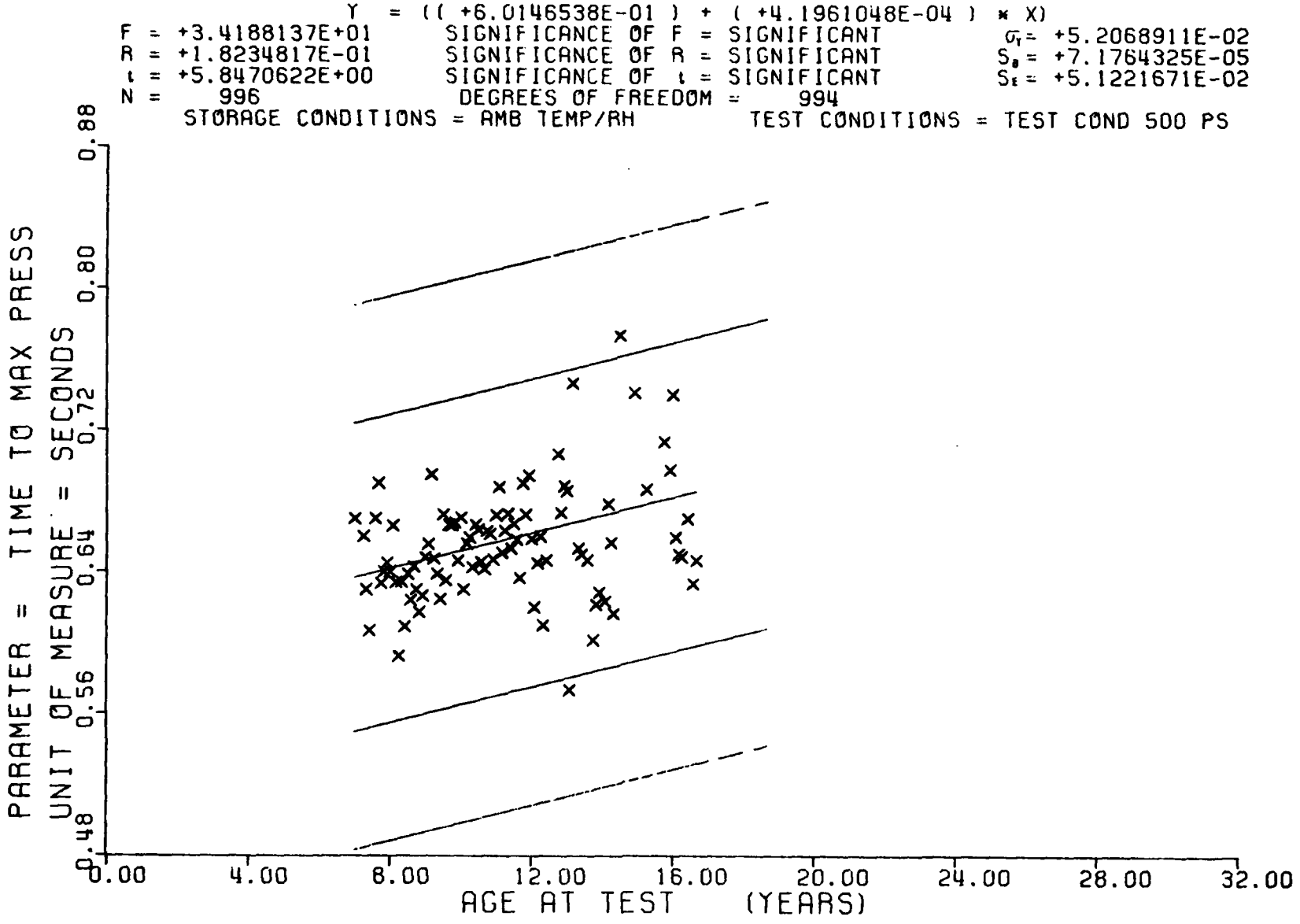
STAGE 1,WING 1&2,PRESSURE TIME,TIME TO MAXIMUM PRESSURE

This sample size summary is applicable to figures 49 and 50



STAGE 1,WING 1&2,PRESSURE TIME,MAXIMUM PRESSURE

Figure 49



STAGE 1,WING 1&2,PRESSURE TIME,TIME TO MAXIMUM PRESSURE

Figure 50

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
78	3	105	21	130	24	157	18
80	8	106	18	131	21	158	3
81	3	107	21	132	12	159	6
82	3	108	18	133	20	164	3
83	9	109	15	134	30	165	6
85	3	110	9	135	9	166	3
86	3	111	24	136	51	167	3
87	9	112	27	137	45	168	6
88	12	113	21	138	33	169	6
89	6	114	21	139	48	188	3
90	3	115	18	140	18	193	18
91	14	116	18	141	18	194	6
92	15	117	45	142	9	195	9
93	3	118	21	143	9	196	9
94	3	119	18	144	9	197	9
95	12	120	24	145	6	200	3
96	9	121	18	146	3		
97	3	122	18	148	9		
98	9	123	26	149	3		
99	6	124	21	150	3		
100	6	125	24	152	6		
101	15	126	35	153	15		
102	18	127	23	154	6		
103	18	128	36	155	12		
104	15	129	29	156	15		

STAGE 1, WING A&B, TP-H1011, BURNING RATE 1000 PSI

This sample size summary is applicable to figure 51

Y = ((+3.4809374E-01) + (-3.0036606E-04) * X)

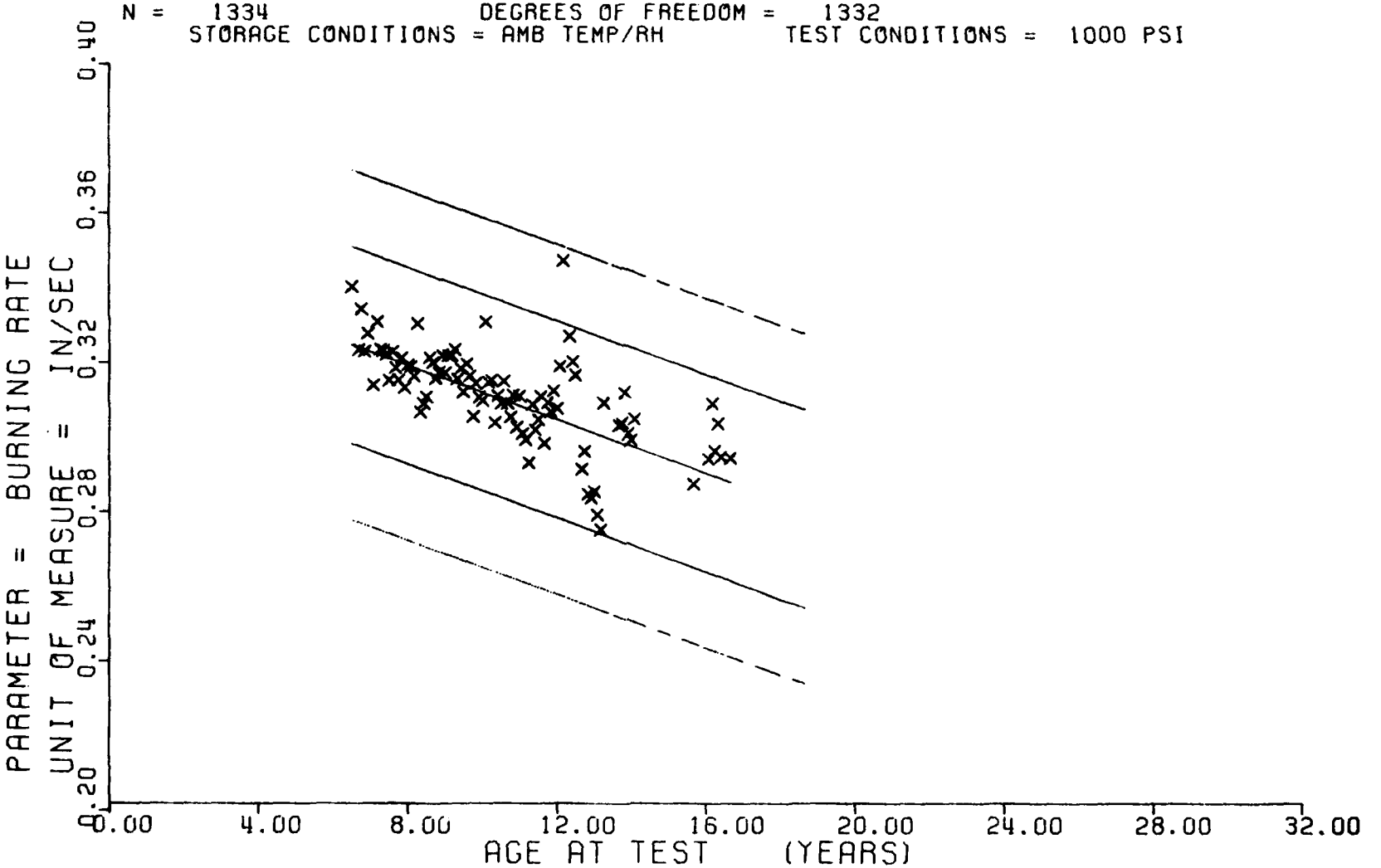
F = +2.6843491E+02 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.7110455E-02

R = -4.0954393E-01 SIGNIFICANCE OF R = SIGNIFICANT S_β = +1.8332907E-05

t = +1.6383983E+01 SIGNIFICANCE OF t = SIGNIFICANT S_ε = +1.5615562E-02

N = 1334 DEGREES OF FREEDOM = 1332

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 1000 PSI



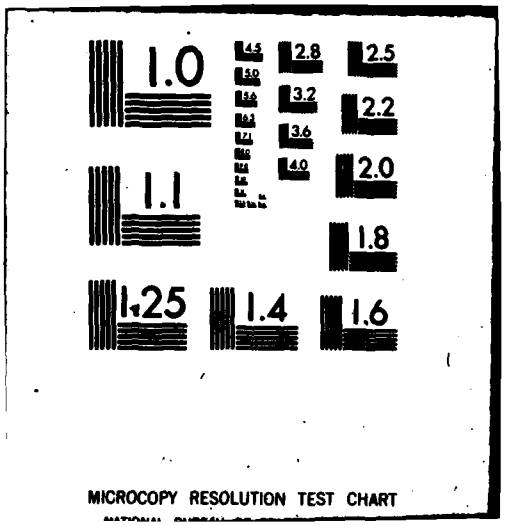
STAGE 1, WING A&B, TP-H1011, BURNING RATE 1000 PSI

AD-A081 493 OGDEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT LAB--ETC F/G 21/9.2
PROPELLANT SURVEILLANCE REPORT LGM-30 A & B STAGE I TP-H1011,(U)
NOV 79 J A THOMPSON

UNCLASSIFIED MANCP-425(79) NL

2 2

END
DATE FILMED
4-80
DTIC

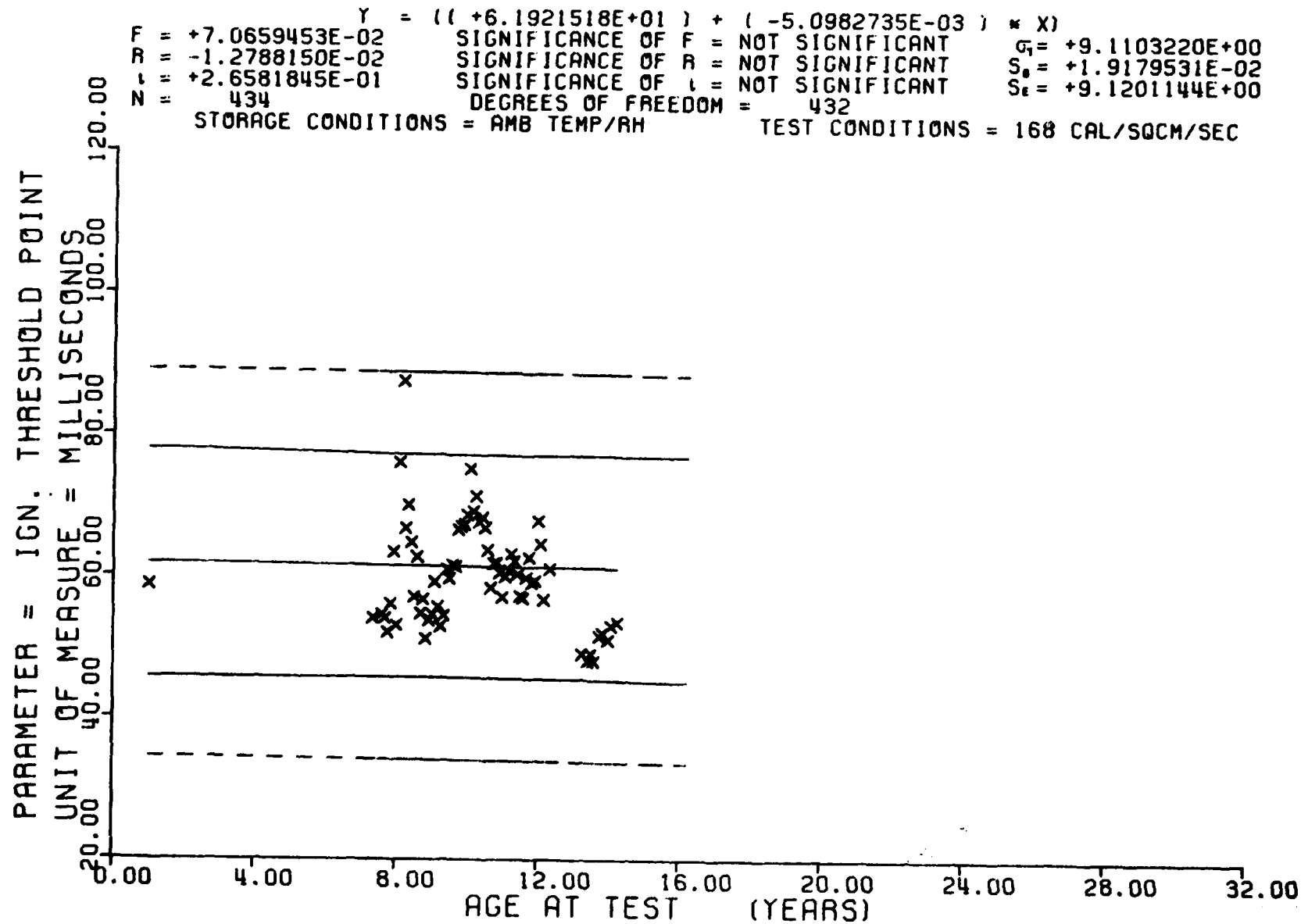

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
12	10	114	12	139	11
90	1	115	0	140	4
91	2	116	10	141	5
92	4	117	0	142	5
93	1	118	6	143	7
94	3	119	12	144	5
95	3	120	8	145	2
96	3	121	8	146	3
97	4	122	9	148	2
98	4	123	12	159	1
99	10	124	5	161	1
100	7	125	11	162	1
101	10	126	9	163	1
102	8	127	11	165	2
103	9	128	8	166	2
104	9	129	4	168	1
105	6	130	6	169	1
106	10	131	7	171	2
107	7	132	5		
108	12	133	9		
109	6	134	11		
110	8	135	8		
111	8	136	8		
112	12	137	8		
113	7	138	15		

STAGE 1 WING 1&2 TP-H1011 IGNITABILITY, IGN THRESHOLD POINT, 168 CAL/SQ CM/SEC

This sample size summary is applicable to figure 52



STAGE 1 WING 142 TP-H1011 IGNITABILITY, IGN THRESHOLD POINT, 168 CAL/SQ CM/SEC

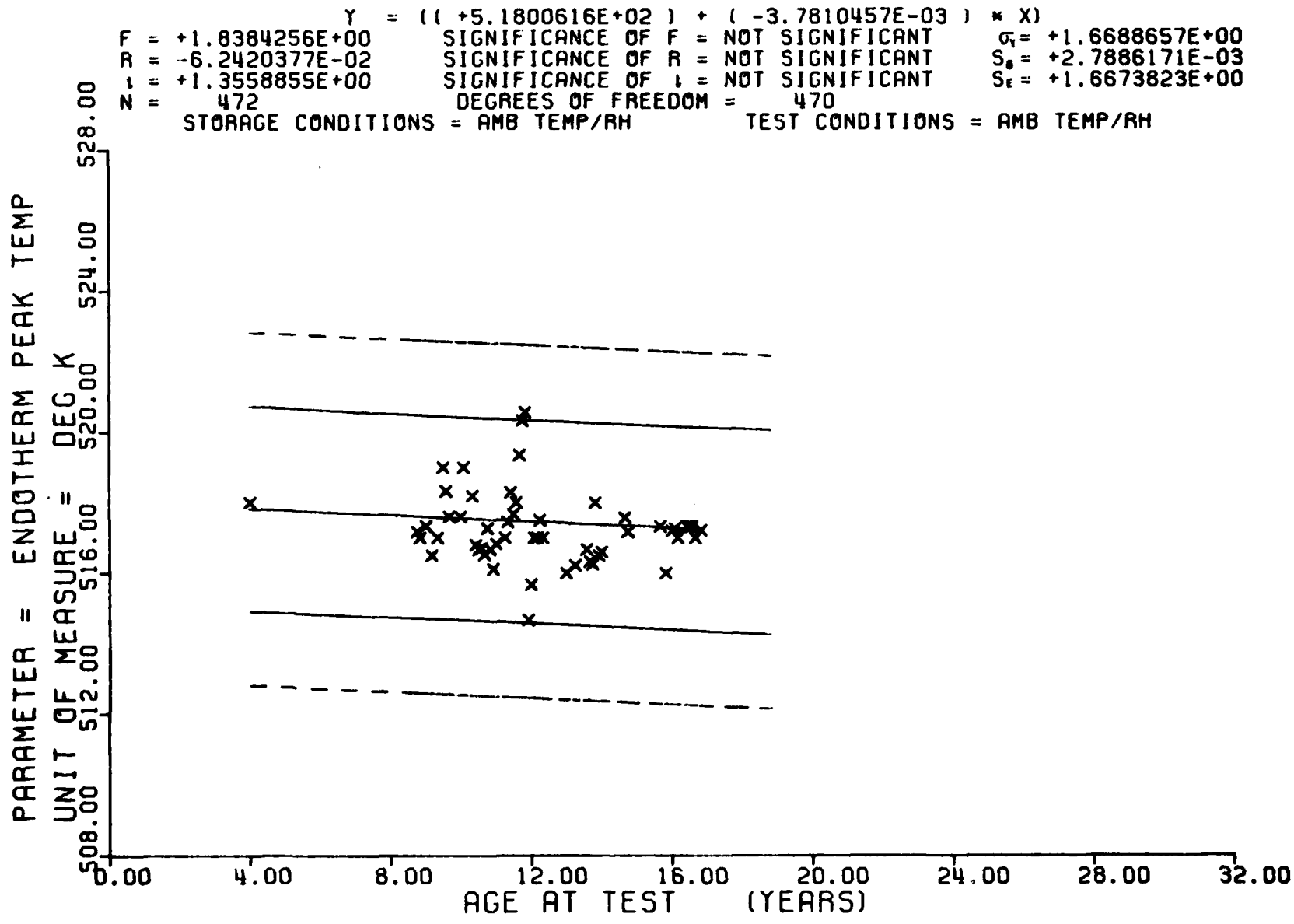
Figure 52

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
48	3	140	23	198	3
103	12	141	15	199	6
106	6	142	9	200	3
108	24	143	3	202	9
110	12	144	3		
112	12	145	5		
114	6	146	7		
115	12	147	6		
116	15	148	3		
120	5	156	3		
121	9	159	9		
124	16	163	3		
125	15	164	3		
126	3	165	4		
127	21	166	1		
128	19	167	6		
129	11	168	5		
130	9	176	7		
131	9	177	6		
132	12	188	3		
135	7	190	3		
136	11	192	10		
137	14	193	11		
138	6	194	9		
139	22	197	3		

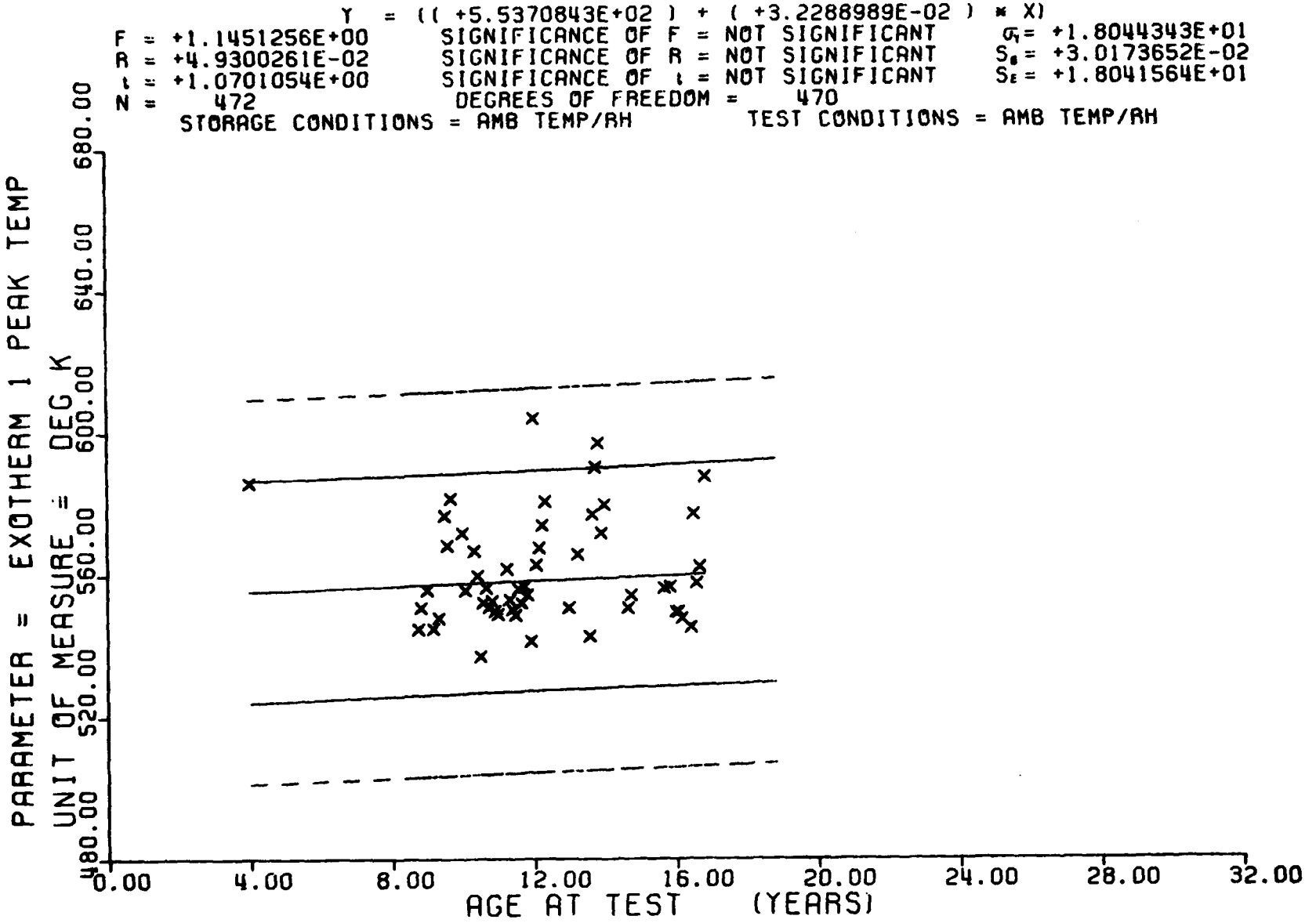
STAGE I WING 162 DIFFERENTIAL SCANNING CALORIMETER ENDOTHERM PEAK TEMP

This sample size summary is applicable to figures 53, 54 and 55



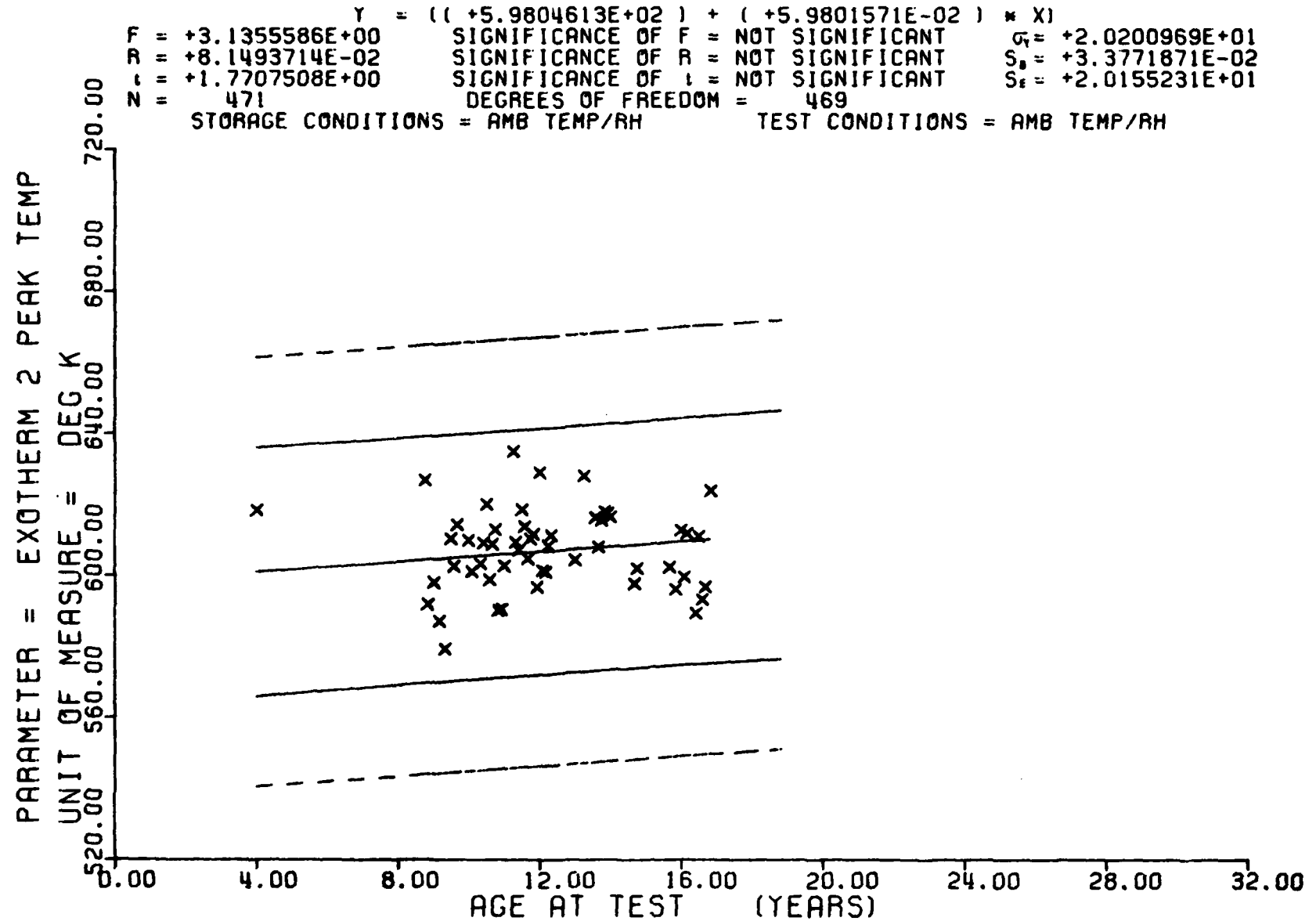
STAGE I WING 1&2 DIFFERENTIAL SCANNING CALORIMETER ENDOTHERM PEAK TEMP

Figure 53



STAGE I WING 1&2 DIFFERENTIAL SCANNING CALORIMETER EXOTHERM 1 PEAK TEMP

Figure 54



STAGE I WING 1&2 DIFFERENTIAL SCANNING CALORIMETER EXOTHERM 2 PEAK TEMP

Figure 55

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
9	6	127	1	198	6
12	4	128	5		
82	1	129	5		
84	1	130	8		
85	1	131	6		
89	2	132	5		
91	4	133	4		
92	1	134	3		
97	6	135	10		
98	9	136	14		
99	4	137	8		
100	5	138	2		
101	1	139	5		
102	3	153	4		
103	3	154	8		
105	3	155	8		
106	1	156	4		
107	3	180	4		
112	2	190	2		
113	3	191	7		
114	6	192	4		
115	3	193	11		
116	3	194	4		
125	3	195	8		
126	1	196	2		

WING 182 STAGE 1 TGA PERCENT WEIGHT LOSS AT IGNITION. 9 DEG C RISE/MIN

This sample size summary is applicable to figures 56 and 57

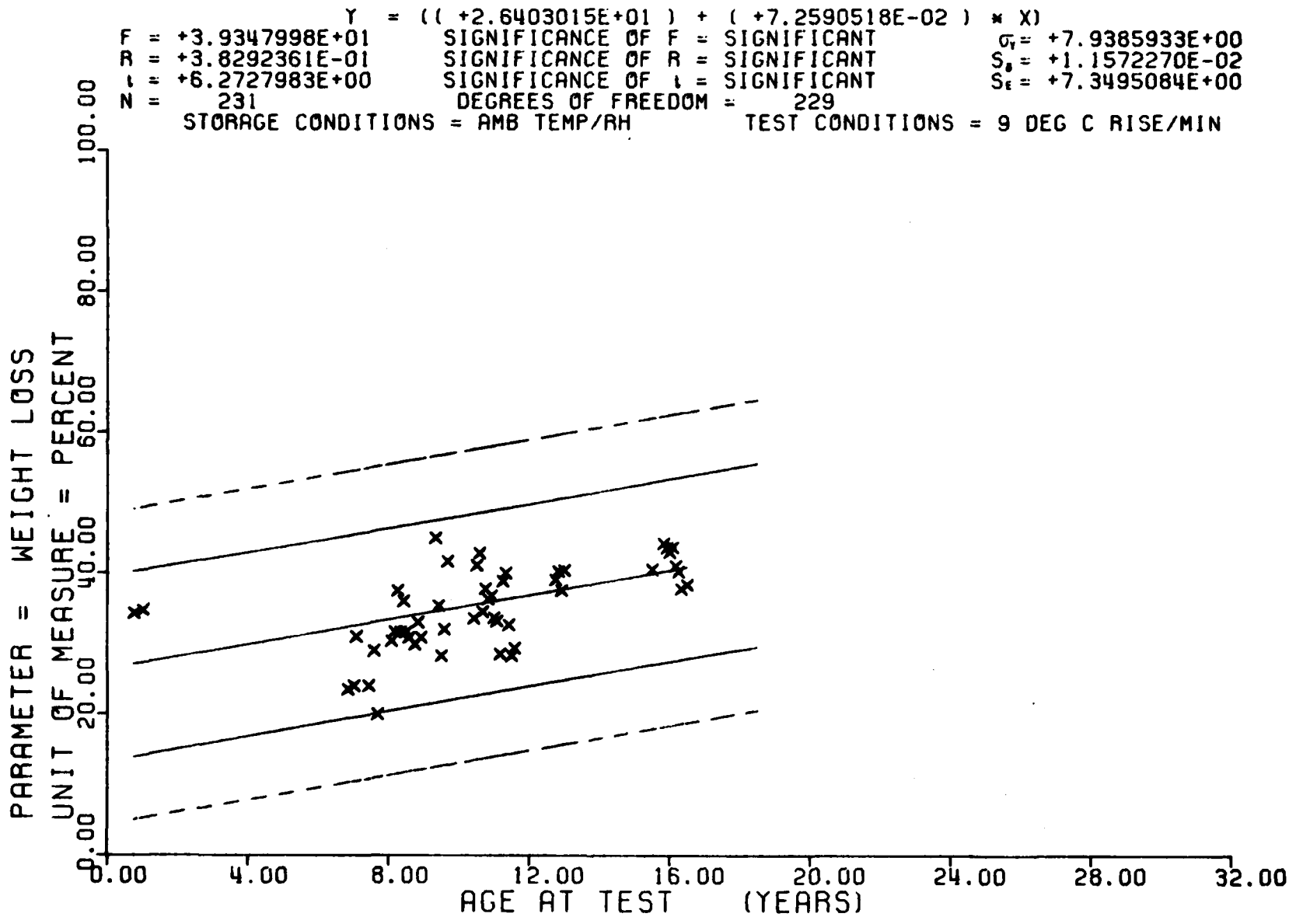

Y = ((+2.6403015E+01) + (+7.2590518E-02) * X)
F = +3.9347998E+01 SIGNIFICANCE OF F = SIGNIFICANT σY = +7.9385933E+00
R = +3.8292361E-01 SIGNIFICANCE OF R = SIGNIFICANT Sβ = +1.1572270E-02
t = +6.2727983E+00 SIGNIFICANCE OF t = SIGNIFICANT Sε = +7.3495084E+00
N = 231 DEGREES OF FREEDOM = 229
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 9 DEG C RISE/MIN
PARAMETER = WEIGHT LOSS
UNIT OF MEASURE = PERCENT
0.00
20.00
40.00
60.00
80.00
100.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
WING 1&2 STAGE 1 TGA PERCENT WEIGHT LOSS AT IGNITION, 9 DEG C RISE/MIN

Figure 56

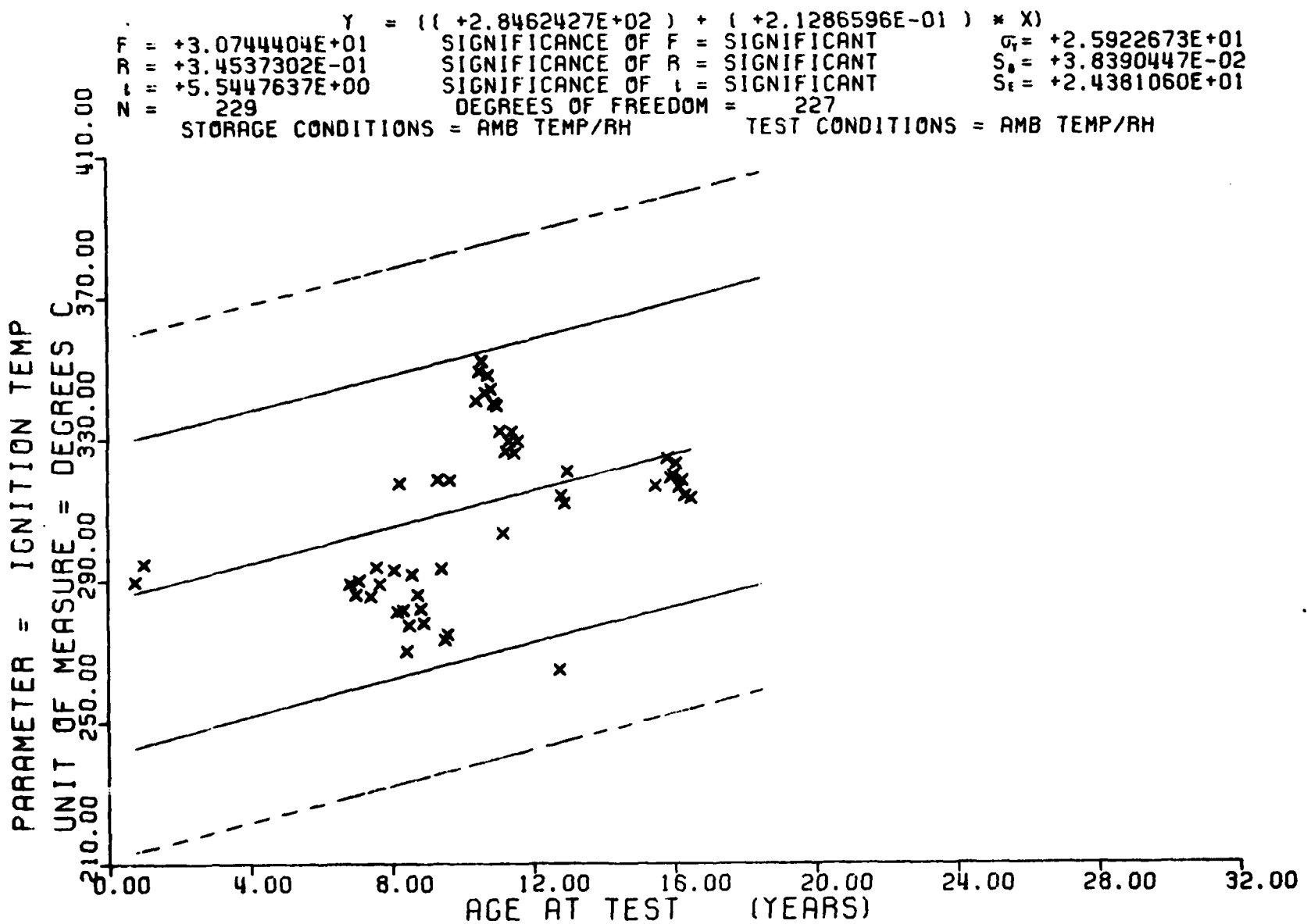

Y = ((+2.8462427E+02) + (+2.1286596E-01) * X)
F = +3.0744404E+01 SIGNIFICANCE OF F = SIGNIFICANT σY = +2.5922673E+01
R = +3.4537302E-01 SIGNIFICANCE OF R = SIGNIFICANT Sb = +3.8390447E-02
t = +5.5447637E+00 SIGNIFICANCE OF t = SIGNIFICANT Se = +2.4381060E+01
N = 229 DEGREES OF FREEDOM = 227
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = IGNITION TEMP
UNIT OF MEASURE = DEGREES C
410.00
370.00
330.00
290.00
250.00
210.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
WING 1&2 STAGE 1
TGA IGNITION TEMPERATURE, 9 DEGREE C RISE/MINUTE

Figure 57

*** SAMPLE SIZE SUMMARY ***

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
9	6	133	2
12	4	134	3
32	1	135	4
34	1	136	5
35	1	137	3
89	2	138	1
91	2	139	2
92	1	153	2
97	4	154	4
98	7	155	4
99	2	156	2
100	1	186	2
112	1	190	1
113	1	191	4
114	2	192	2
115	1	193	6
116	1	194	2
125	1	195	4
126	2	196	1
127	1	198	3
128	2		
129	1		
130	1		
131	2		
132	2		

%ING 162 STAGE 1 % WT LOSS AT 250 DEG C HOLD, 12 DEG RISE/MIN TO HOLD

This sample size summary is applicable to figure 58

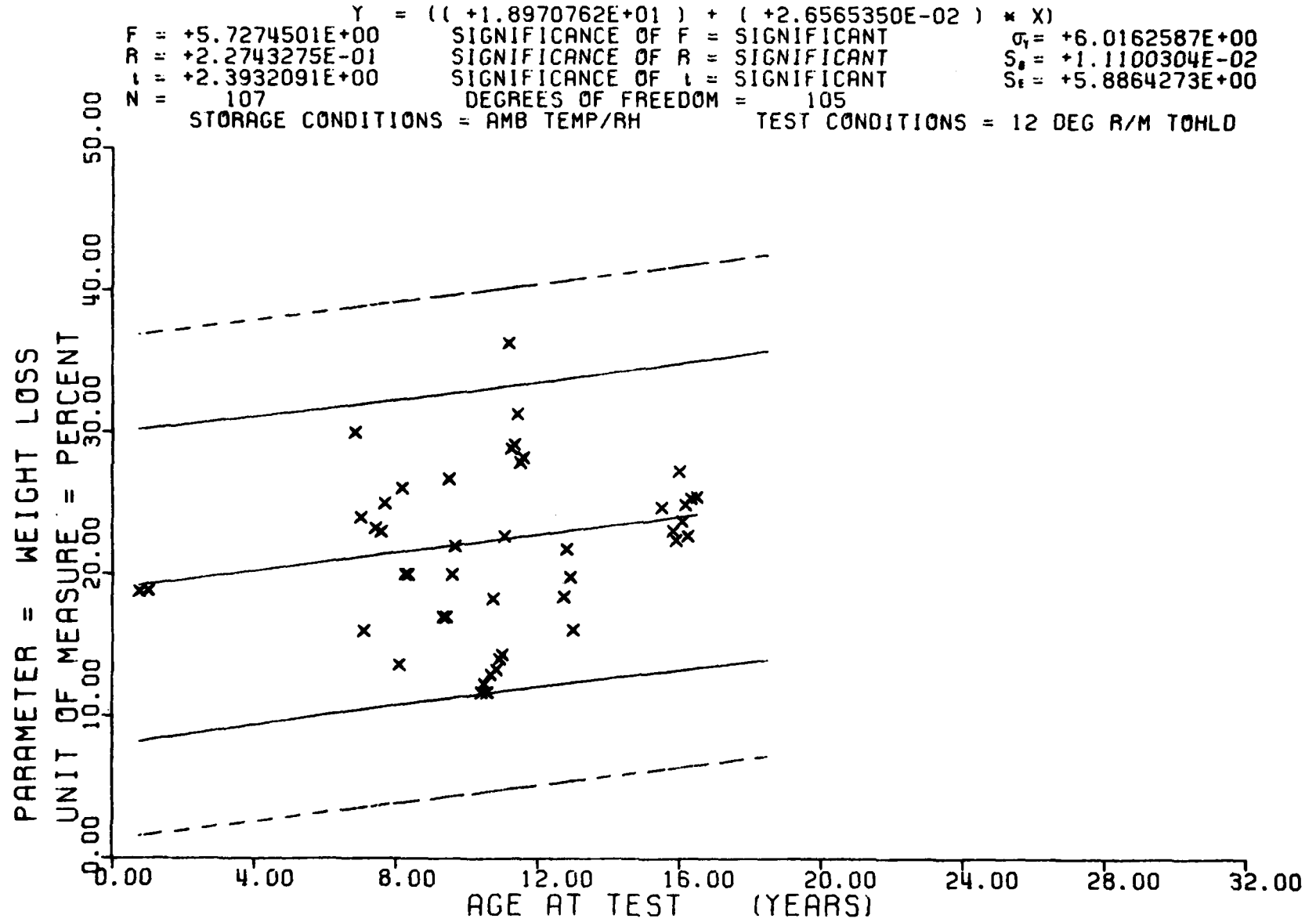

Y = ((+1.8970762E+01) + (+2.6565350E-02) * X)
F = +5.7274501E+00 SIGNIFICANCE OF F = SIGNIFICANT σY = +6.0162587E+00
R = +2.2743275E-01 SIGNIFICANCE OF R = SIGNIFICANT Sβ = +1.1100304E-02
t = +2.3932091E+00 SIGNIFICANCE OF t = SIGNIFICANT Sε = +5.8864273E+00
N = 107 DEGREES OF FREEDOM = 105
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = 12 DEG R/M TOHLD
PARAMETER = WEIGHT LOSS
UNIT OF MEASURE = PERCENT
0.00
10.00
20.00
30.00
40.00
50.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
WING 1&2 STAGE 1
% WT LOSS AT 250 DEG C HOLD, 12 DEG RISE/MIN TO HOLD

Figure 58

DISTRIBUTION

	NR COPIES
OOALC	
MMWRME	1
MMWRMT	1
DDC (TISIR) Cameron Station, Alexandria, VA 22314	2
AFPRO, Thiokol Chemical Corporation Wasatch Division P.O. Box 524 Brigham City, UT 84302 (Cy to R. E. Keating)	2
AFRPL (MKPB) Edwards AFB, CA 93523	1
SAC (LGMB) Offutt AFB, NB 68113	1
U. S. Naval Ordinance Station, Indian Head, MD 20640 ~~Attn: Dr. James H. Wiegand~~ Fleet Support Dept., Propulsion System Development Division, Code FS7	1
CPIA, Johns Hopkins University ~~Attn: Dr. P. L. Nichols~~ Applied Physics Laboratory Johns Hopkins Road Laurel, MD 20810	1
Naval Plant Branch Representative Attn: Mr. David W. Pratt P. O. Box 157, Bacchus Works Magna, UT 84044	1

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MANCP Report Nr 425(79)	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Propellant Surveillance Report LGM-30 A & B Stage I, TP-H1011		5. TYPE OF REPORT & PERIOD COVERED Test Results - Semi Annual 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) JOHN A. THOMPSON		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Propellant Lab Section Directorate of Maintenance OO-ALC Hill AFB, Utah 84056		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS MMWRM Project M82934C-WNL-17514
11. CONTROLLING OFFICE NAME AND ADDRESS Service Engineering Division Directorate of Materiel Management OO-ALC Hill AFB, Utah 84056		12. REPORT DATE November 1979 13. NUMBER OF PAGES 113
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for Public Release, Distribution Unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Solid Propellant Minuteman		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report contains propellant test results from cartons of TP-H1011 bulk propellant representing LGM-30 A and B First Stage Minuteman Motors. Testing was accomplished in accordance with MMWRM Project M82934C-WNL17514. The purpose of testing was to determine and provide early warning of any serious degradation trends occurring in the propellant for service life predictions.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

An analysis of all parameters indicates that no potential problems are expected in the propellant for at least two years past the oldest data point.

Data stored in the G085 System were plotted utilizing the IBM 360-65 Computer and CAL-COMP Plotter. The data range at any age can be found by suitable inquiry of the G085 System.

Each point on the regression plot represents the mean of all samples at that particular age. The number of specimens at each point is indicated on the sample size summary sheet accompanying each regression plot or group of regression plots.